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FOURTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

PHILIPPINE ISLANDS

TO THE HONORABLE
THE SECRETARY OF THE INTERIOR

BY

ALVIN J. COX
DIRECTOR OF THE BUREAU OF SCIENCE

FOR THE YEAR ENDING
DECEMBER 31, 1915

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FOURTEENTH ANNUAL REPORT OF THE DIRECTOR OF THE BUREAU OF SCIENCE

The GOVERNMENT OF THE PHILIPPINE ISLANDS,
DEPARTMENT OF THE INTERIOR,
BUREAU OF SCIENCE,
Manila, January 1, 1916.

SIR: I have the honor to submit the following account of the Bureau of Science and the work performed therein from January 1 to December 31, 1915. In the space which I propose to devote to the purpose it will be scarcely possible to mention all its activities, but I shall briefly discuss the Bureau's important, and some of the less familiar, lines of work and indicate its needs.

The demands upon the Bureau of Science have increased during this year as they have during each preceding year. The amount of work done for pay has amounted to ₱98,197.62 for the year as compared with ₱104,880.62 for 1914, ₱96,634.81 for 1913, ₱88,191.18 for 1912, and ₱81,510.12 for 1911. The increase in routine examinations is shown by the following table:

	1907	1911	1915
Chemical and physical analyses and tests of metals, minerals, clays, cements, fertilizers, soils, fuels, waters, papers, gums and resins, foods, drugs, etc	3,064	9,193	10,765
Examinations of fæces, urines, blood, sputum, gonococci, rabies, rats for plague, and miscellaneous bacteriological examinations	26,449	35,645	169,270
Total analyses, tests, and examinations	29,513	44,838	180,035
Available appropriation	₱381,838.28	₱512,250.76	₱379,890.00

In spite of a large increase in the amount of routine work during the last year and a decrease in available appropriation and in the face of other adverse circumstances, I consider it a great credit to the employees of this institution that they have been able to carry on so much work, all tending to improve sanitary conditions, to develop the valuable resources of the

Philippine Islands, and to develop both old and new industries—work which should be carried on at all times. I desire to thank each and every employee for his coöperation and devotion to duty.

Many of the valuable resources of the Philippine Islands are insufficiently, or not at all, developed. I have endeavored to direct the work of the Bureau of Science in such a way that a study of the problems connected with some of these should be in progress at all times. There is a necessity for work merely to arouse further interest in Philippine resources and to stimulate the development of both old and new industries. Profitable modifications of old methods are not always readily accepted by the people most concerned and should be thoroughly demonstrated.

The Bureau of Science is charged by law with the performance of work for all branches of the Philippine Government requiring laboratory facilities. There are continually more and more demands upon the Bureau of Science for consultation work such as mine examinations, advice such as is given by a consulting chemist, etc. There is scarcely a day when I am not conferred with regarding one or more commercial problems. There are very few technical men in the Archipelago outside of the Government, and there are few industries developed to the extent where they can afford the continuous services of a technical man; the Government should recognize this and provide sufficient personnel for special consultation work, which will prevent loss to the producer, the manufacturer, and the commerce of the country.

NECESSITY FOR SYSTEMATIC WORK

Botanical and zoölogical work, especially systematic work, involving the collection, preservation, and classification of specimens, seems to many persons to be as impracticable and unproductive as the formation of a collection of postage stamps—a pleasant hobby. A botanical collection may be taken as an example, for the same arguments apply to collections of plant specimens as are applicable to bird, insect, and other zoölogical collections. A herbarium of properly named specimens bears somewhat the same relation to a study of timber trees, medicinal plants, rubber-producing trees and vines, fibers, resins, dye woods, etc., that a dictionary does to the production of an essay, an editorial, or the description of a piece of machinery. Were the vegetation of the Philippine Islands well known, there would have been absolutely no justification for the Bureau of Science or other branch of the Government to have built up a general herbarium or to have given much attention to systematic work. However, little work had been done. There was, and is now, except in the Bureau of Science, absolutely no institution in the world where Philippine Islands specimens could be sent for identification, yet classification and accurate identification of material must precede all economic investigations. The material in the Bureau of Science herbarium has been used in the classification and identification of the classes of economic plants enumerated above and of all other known Philippine species. Groups of plants that are known to be of no economic value, such as ferns, mosses, lichens, orchids, etc., are not studied by the employees of the Bureau of Science. All plants of a country, except those of such groups, must be studied, else many economic plants would not be collected and identified. To work solely on plants known to be of economic value would be analogous to compiling a city directory and including only the names of persons who were of value to the city. The fact that a plant is related to another, known to yield a valuable product, may lead to the discovery of a new economic source of that product.

The publication of the results of the study of a collection is as important as its formation. The actual as well as scientific value of any collection is potential until the specimens have been identified by specialists and have become the data upon which systematic reports are based. The most valuable specimens in any collection are the "types." A type is the specimen selected by an author to represent a new species described by him. He may have any number of specimens before him, but he should draw his description from a single specimen which he should designate as "type." In the best taxonomic work of the present time the collection serial number of the type and other data serving to locate it are given. Types add to the value of a collection not only because they are the best possible means of identifying other specimens, but also because a type is unique and, therefore, beyond price. The value of a collection is being continually enhanced in the hands of a man who compares his specimens with original descriptions and with the types or cotypes and describes and publishes the new species and genera he finds and records new facts in the distribution of known species. On the other hand, the identical collection cared for by a man who does no more than sort the specimens into their families or genera rapidly decreases in value because the percentage of types and historical material rapidly decreases. The increase in value of a specimen that has been compared with the type of its species or that has been labeled by a specialist is somewhat similar to that which takes place in a meter rod when it is compared with the standard meter measure now kept at Sevres, France. The collections of the Bureau are very valuable on account of the high percentage of its types, cotypes, and compared specimens.

Prior to 1900 practically no botanical work of importance had been accomplished in the Philippine Islands. Systematic work had to precede all other lines of botanical investigation. For example, without such work the present commercial classification of Philippine timbers would have been absolutely impracticable. The botanical material of the Bureau of Science has been turned over for identification to specialists wherever they could be found willing to work on the material. The lichens have been sent to a man in Finland, the mosses to another man in Finland, the hepatics to one in Germany, the orchids to one in America, and so on for a score of groups. Thus the Philippine Government has had the benefit of the trained services of numerous specialists in England, Germany, Switzerland, Finland, Holland, Denmark, and the United States merely by sending a set of duplicate specimens. Only those groups for which no specialists could be found have been worked in Manila.

PUBLICATION

The publication of the results of the study of a collection of biological specimens and of all other investigations is absolutely necessary. In my last annual report I pointed out that high-grade character in publication could not be maintained by bulletin issues. For the same reason, among others, the Philippine Journal of Science was started in 1906. The United States Department of Agriculture followed the example of the Bureau of Science when it established the Journal of Research in 1914. Besides improving the character of the work and avoiding the confusion that results from a multiplicity of series of publications, there are many reasons, any one of which justifies the publication of the Philippine Journal of Science, as follows:

1. The larger part of the current serial literature in the Bureau of Science library has been received in exchange for the Philippine Journal of Science. The value of these publications, together with the cash sales of the Philippine Journal of Science, makes the latter practically self-supporting. A series of bulletins issued either free or at cost has very little exchange value and is not acceptable to many institutions.

2. If there were not a single advantage to the public in having

scientific articles in printed rather than in manuscript form, there is a saving to the Philippine Government in salaries of more than the cost of printing the Philippine Journal of Science in the stimulus that the prospect of future publication of worthy articles gives to the scientists.

The research work of the Bureau of Science costs practically nothing. The men now employed are necessary for the regular work. With the stimulus of publication, the men now are always busy during office hours and often work hours and hours overtime on research work. This is not done for the Bureau, but for the man himself, and the Philippine Islands profit.

3. The publication of the Philippine Journal of Science gives a standing to the institution and the Government which could not be obtained in any other way. The China Medical Journal of November, 1915, speaking of its exchanges, under the heading of the Philippine Journal of Science, says:

> The contents of this number of the Journal are of the usual high standard of scientific interest. [25 printed lines discussing the published papers.] The paper on the "Treatment of Infantile Beriberi," by Albert, is of so much interest in connection with our own discussion of Beriberi, that the JOURNAL has taken the liberty of reprinting it. The record of the Eleventh Annual Meeting of the Philippine Islands Medical Association, held in 1914, completes this valuable number.

On account of the Philippine Journal of Science we have been able to attract and retain men of ability whom we should not have been able to get in any other way.

4. The Philippine Journal of Science is known all over the world. In many institutions, when I was in the United States on leave and introduced myself, I received the reply: "Yes, I know the Philippine Journal of Science."

5. It is impossible for any one to cull accurate information from another's rough notes. The Philippine Journal of Science is a permanent record of the best of the work of former employees of the Bureau of Science. The economy of such a publication is shown by the time saved in answering inquiries by this and other offices of the Government. A great deal of information of former employees of the Philippine Government has been lost because no adequate record was made.

6. The Philippine Journal of Science is intended as the scientific organ of the Philippine Government, and any worthy articles containing original material regarding Philippine problems are printed; thus Philippine material is brought together in one place.

7. We are attempting to train here in the Philippine Islands a corps of Filipino scientists. The only standard medium of

publication available to the corps of assistants now being trained in the Bureau of Science and in the University of the Philippines is the Philippine Journal of Science, which has a well-established international reputation in the scientific world. In this connection attention is called to the fact that in many of the large cities of the East—Tokyo, Shanghai, Singapore, Batavia, Buitenzorg, Calcutta, Rangoon, Bombay, and many others—scientific publications are issued. Practically without exception these scientific publications are supported wholly or in part by the governments of the different countries. It is true that some are published by scientific societies, but invariably the scientific society receives a subsidy from the local government to cover, at least in part, the cost of publication and distribution.

FAR EASTERN ASSOCIATION OF TROPICAL MEDICINE

The fourth biennial congress of the Far Eastern Association of Tropical Medicine will meet in Batavia in June, 1916. The stimulus of thought and the benefit derived from an organization of this kind is very great, not only to the delegates, but also to the institutions which they represent, especially in this part of the world where the scientific worker is isolated to a great extent. It is hoped, therefore, that this institution can be represented at the sessions.

PHILIPPINE ISLANDS MEDICAL ASSOCIATION

No meeting of the Philippine Islands Medical Association was held in 1915.

CONGRESS OF PHYSICIANS AND PHARMACISTS

The third congress of physicians and pharmacists will be held in Manila from February 7 to 11, 1916, inclusive. The meeting is held under the auspices of the Colegio Medico-Farmaceutico of the Philippine Islands. The Bureau of Science is to contribute seventeen papers to be read at the various sections as follows:

Food inspection, by H. C. Brill.
Estudio bacteriologico de las aguas potables en Pasig, by Ariston Guzman.
Parasitos intestinales del hombre en Filipinas, by Ariston Guzman.
Manila swimming pools from a bacteriological standpoint, by C. E. Gabel.
Biological examination of Manila water supply, by C. E. Gabel.
Fish as a food supply, or the sea harvest, by Alvin Seale.
Fake medical appliances, by T. Dar Juan.
Industria del curtido de pieles, by V. Q. Gana.
Water analysis in the field, by George W. Heise.
Analytical standards for Philippine waters, by George W. Heise.
Water supply for the city of Iloilo, by George W. Heise.

The chemical constituents of chaulmoogra oil, by H. C. Brill.
The ferric chloride test for salycilic acid, by H. C. Brill.
The chemical purification of swimming pools, by George W. Heise and R. H. Aguilar.
A study of mothers' milk, by Ariston Guzman.
Investigation of the medicinal plants of the Philippines, by E. D. Merrill.
Some vegetables grown in the Philippines, by F. Agcaoili.

INSTRUCTIONS TO DISTRICT HEALTH OFFICERS

The Director of Health conceived the idea that his district health officers could do their work better, if they had a little idea of the work which is carried on in the Bureau of Science, and would know better how to prepare specimens to be sent to the Bureau of Science for examination, if they took a short course in this work. The Director of Health discussed his plan with the undersigned, and it was approved. The bacteriologists of the Bureau of Science began the instruction on October 11, 1915, when Dr. Eugenio Hernando, district health officer of Bulacan; Dr. Rafael Villafranca, district health officer of Tayabas; Dr. Vicente Rivera, district health officer of Laguna; and Dr. Antonio Fernando, district health officer of Nueva Ecija, were detailed to the Bureau of Science for six weeks of laboratory and practical instruction. These men learned better how to prepare materials and reviewed the most frequently used bacteriological examinations.

STANDARDIZATION OF SUPPLIES

For several years the Bureau of Science has been urging the desirability of standardization of supplies and the establishment of certain qualities of material for Government use. The standardization of measuring apparatus in the Islands is well in hand, and as pointed out in my last annual report, as a result of the examination by this Bureau during the past seven years certain materials purchased by the Government were standardized and purchased under specifications, and in each instance a remarkable increase in the quality has been noted. On June 24, 1914, his Excellency, the Governor-General, issued Executive Order No. 62, appointing a Committee on Standardization of Supplies. Except the Director of the Bureau of Science, all the other members of this committee have resigned during the past year, and I was away on leave in the United States for a period of several months. Since my return the committee has been reorganized and is now endeavoring to eliminate inferior materials and to systematize, classify, and effect economy in the purchase of general supplies. Standardization in chemicals refers to purity; in machine tool equipment and accessories it refers not only to cost and quality but to interchangeability, that is, uniformity of dimensions of machine parts. The whole world now recognizes the necessity of standardization, if time is to be saved and if operation and production are to be kept at a low cost. There is a large saving to the Government by the elimination of a large assortment of different articles serving the same purpose. It will take a long time to pass on the thousands of articles needed by the Government. The war in Europe has interfered with our sources of supplies. Prices of staple articles have increased from 10 to 200 per cent, and of certain chemicals, from 500 to 1,000 per cent; freight rates are steadily rising; and prices are continually advancing. It is anticipated that the work of the committee will be extended to include the investigation and redistribution of serviceable supplies, materials, and equipment now on hand in the various branches of the service. The successful solution of many of our local problems concerning supplies and materials must be solved by local research. The available information on many of these subjects is very meager, and only a few general results are applicable to the Philippines; for example, there is practically no material of construction used in the Islands upon which there is not a great deal of work to be done. Every branch of the Government that has to deal with construction materials realizes the importance of studies of this kind and the limited provision that has been placed at the disposal of the Bureau of Science for carrying it on.

ELECTROLYSIS COMMITTEE

The Electrolysis Committee consists of the Superintendent of Water Supply and Sewers of the city of Manila, the City Electrician, the City Boiler Inspector, the Director of the Bureau of Science, and a representative of the Manila Electric Railroad and Light Co., of the Philippine Islands Telephone and Telegraph Company, and of the Manila Gas Corporation, respectively. Many of the members of the old committee have left Manila, and a new committee is soon to be appointed to carry on the work. Many interesting developments have occurred in the past, and the interesting problem of determining the causes of several aggravated cases of boiler condenser-tube corrosion in local factories was presented for solution. The trouble in some cases was attributed to stray currents.

MANUFACTURE OF EXTRACT OF TIQUI-TIQUI

Under the provisions of Act No. 2376 the Bureau of Science has continued its work of preparing extract of tiqui-tiqui for the treatment of infantile beriberi. The work is of great practical importance. A stock has been continually kept on hand, and up to the close of the year 200 liters of extract have been prepared, probably sufficient to treat 3,500 infants, as compared with 58 liters of extract prepared in 1914. Slightly less than one half of the funds appropriated by Act No. 2376 has been expended.

MAINTENANCE OF STAFF

Continued agitation with regard to the Bureau of Science has made it impossible to hold out inducements to new or assurances to old employees, has influenced some of the best of our oldest and most experienced men to resign when other opportunities for employment offered, and has made it difficult to secure new employees of ability. Unless a fixed policy is adopted with respect to the Bureau of Science, it will be impossible to maintain a service with its former efficiency.

REPORT OF ASSEMBLY COMMITTEE

In accordance with Assembly Resolution No. 108, dated November 9, 1915, a Special Committee of five members was appointed by the Speaker of the Assembly to investigate and make recommendations before January 1, 1916, concerning "the utility and desirability of uniting the branches of the Government which have to do with agriculture in order to avoid unnecessary duplication of work, to abolish unnecessary expenditures and to coordinate and increase the efficiency of the work." Extracts from the report of the committee thus appointed follow:

> The members of the Committee have made every possible investigation tending to cast any light on the business intrusted to them. They have visited all the offices in any way affected by the Resolution and have conferred with all the chiefs of the respective bureaus. They have cited witnesses, heard their declarations, and obliged them to state their opinions, having held public sessions on the 19th and 23d of November and the 4th of December of this year. Various documents referring to the matter have been consulted in the files of the Executive Secretary's office. The Committee even made several trips, one to Los Baños, where the College of Agriculture is, one to Limay, Bataan, where there is a Forest Station, and finally to Lamao, in the same province, where there is an Agricultural Experiment Station.
>
> We here wish to express our satisfaction with the cordial and valuable coöperation granted us by every one of the bureaus interested in the matter and to put on record our appreciation of their aid.
>
> It is the opinion of your committee that much of the confusion and divergence of opinion which has existed in the past in reference to the general subject under consideration here have been due to the lack of a clear and definite understanding of the various forms of agricultural activity which should be carried on by the Government and of just where

and what the limits of the jurisdiction of each of the subordinate bureaus should be * * *.

BUREAU OF SCIENCE

In no other division of its labors has your committee proceeded with greater caution and we believe with greater thoroughness than in that which refers to the Bureau of Science. This was necessary both because of the highly scientific work in which the Bureau is engaged and also because of the various criticisms which have been made for years past. Your committee confesses that at the time of beginning the investigation of the Bureau of Science we were rather prejudiced against it and were inclined to think that it was an expensive and unnecessary governmental activity, but the deeper we went into the matter, the more certain it seemed to us that both in its theoretical as well as in its practical work the Bureau of Science has rendered abundant return for the money which it has cost. Its work is far more practical and is of much greater and more immediate material value than is popularly supposed.

In theory, as well as practically, the organization of such an institution as the Bureau of Science is excellent, involving as it does the centralization and concentration of all governmental and scientific investigations, thereby, on the one hand, assuring better results as to efficiency and economy and, on the other, preventing the so often criticized duplication of almost identical work by different organizations. The amount of investigation work carried on in the Philippine Government is not large as compared with that of many other countries in the world, but it is very varied. Thus the Bureau of Health must perform or have performed laboratory work in chemical, botanical, entomological, microscopical, bacteriological, and pathological branches. The Philippine General Hospital needs similar facilities. The professors and advanced students of the University demand the same facilities for carrying on important work. The Bureau of Agriculture needs similar laboratory facilities for its work, and the Bureau of Forestry needs a certain amount of research work in relation to forestry. The Bureau of Public Works must have a large number of chemical analyses made to test the materials of construction used in architecture and engineering, and similar analyses are needed by the Bureau of Supply, the Bureau of Customs, and the Bureau of Internal Revenue.

Adequate laboratory equipment is exceedingly expensive, and the amount of work needed by few, if any, of the bureaus above mentioned is sufficient to justify the equipment and maintenance of an independent laboratory with the necessary subordinate personnel, etc. In the aggregate, however, the work of such character performed by *all* bureaus of the Government is amply sufficient to justify the expenditures required for maintaining the Bureau of Science, which was formerly known as "The Bureau of Government Laboratories." Here all of the investigative work requiring laboratory facilities can be performed adequately and comparatively inexpensively for all branches of the Government.

Nor is this the only reason that can be adduced in favor of maintaining the Bureau of Science. Not only in the matter of equipment is centralization necessary but it is also necessary in order to avoid duplication and in order to utilize to the fullest extent the results of all investigation work. In a country like the Philippines, which in a scientific sense is a new field, there must also be carried on a large amount of investigative work which at first seems to have no bearing or immediate relation to th necessities or present work of any other bureau, but is nevertheless necessary to serve as a basis for work which later will be obviously directly applicable. The details of any subject cannot be considered intelligently without first knowing its general outlines. Thus, for example, before the Bureau of Health can adequately study the transmission of diseases due to insects or vermin, it is necessary that there be performed a large amount of work on Philippine entomology in general. Similarly, before the Bureau of Agriculture can adequately investigate such a disease as that of coffee blight, it is necessary that a considerable amount of work on the fungi of the Philippines shall have been carried on. In the same way, in order to enable the Bureau of Forestry properly to identify the commercial timber trees of the Philippines, a ground work in Philippine botany is needed.

These considerations it seems to your Committee furnish the justification for much of the work which has been carried on by the Bureau of Science in past years and which has been characterized by the public in general as "impracticable." In the opinion of your Committee it is not "impracticable" and should not be considered so merely because it does not immediately and directly result in material value, but, on the other hand, it furnishes the fundamental basis for more obviously practical studies.

We believe that this rather long introduction is necessary for a full understanding of the recommendation which we are about to make.

1. We believe that the Bureau of Science should be intrusted with all laboratory equipment needed by any branch of the Insular Government, particularly by any branch located in Manila; and so far as possible, a similar plan should apply to the provinces. This is the best, in fact the only way, to avoid unnecessary and expensive duplication of equipment.

2. We believe that all scientific collections which are liable to be used by more than one bureau should be assigned to the Bureau of Science. We have already spoken of the undesirability of having the entomological collections of the Government housed at the College of Agriculture near Los Baños, where they are inaccessible to other branches of the Government and to the public in general and where, as has been shown, only a small proportion of the collections are used by the students and where the collection, by distracting the interest and attention of the students and professors, interferes with their strictly agricultural studies. Your committee believes that it should be returned and housed in its original location in the Bureau of Science where it will be available for use by the Bureau of Agriculture, the various branches of the University in Manila, the Bureau of Education, the Bureau of Forestry, and other branches of the Government, as well as by the public in general and by visiting scientists.

Similar considerations hold in reference to the botanical collection known as the Philippine herbarium, which for several years has been housed in the Bureau of Science, where we believe it should remain. To transfer this Government herbarium to any other institution outside of Manila would inevitably reduce its value to a mere fraction of that which it now possesses. The herbarium was founded and now exists not for the use of any one department of the Philippine Government nor even for the Government alone. It has become one of the greatest herbaria of the Orient. It contains tens of thousands of specimens which are of no special interest or value to the instructors and students in the College of Agriculture or to the members of any one bureau, but which are of constant and very great value to other departments of the Government (Bureaus of Education, Forestry, Internal Revenue, Customs, etc.), to the students in the various colleges in the University of the Philippines (particularly the Colleges of Liberal Arts, Pharmacy, and Medicine), to private botanical collectors, and to the students and visiting scientists from foreign countries.

The centralization of scientific research in a single bureau such as in the Bureau of Science also greatly increases the ability of the Government to meet a sudden emergency such as, for example, that made necessary by a sudden outbreak of bubonic plague or of cholera when thousands of rats and a similar number of specimens of fæces must be examined accurately and quickly. It is impossible, of course, to predict when such an outbreak will occur, and therefore there must be kept, somewhere in the Government service, a staff of men capable of responding to an immediate call. By having such men held as members of the Bureau of Science not only do they form a more mobile and efficient corps than would be possible if they were split up among various bureaus, but their spare time between emergency calls, when they would otherwise be more or less idle, can be used to full advantage by the Government in having them carry on the various scientific investigations such as those referred to above.

It is also desirable to take into consideration the mutual stimulus and enthusiasm which result by bringing all or most scientists together in one place for the performance of their various work. By having all such men in one institution there is close coöperation between those representing the different but allied sciences, and a great deal of work is accomplished which no one man could work out alone and which would not be attempted were the individuals isolated * * *.

TRANSLATIONS

The Bureau of Science has no official translator, and several of the scientific men have worked faithfully in translating into Spanish and Tagalog some of the results of the work of the Bureau of Science which are of great interest to the public. The following list gives a general idea of the work accomplished along this line:

Notas sobre el beriberi (Williams). [Read before the Colegio Medico-Farmaceutico.]

La mejora de la industria del curtido de las Islas Filipinas. [Press Bulletin No. 41.]

Notas sobre el suministro de aguas (Heise). [Read before the Colegio Medico-Farmaceutico.]

Notas de interes para los hacenderos de azucar (Thurlow). [Press Bulletin No. 35.]

La industria del azucar en Negros (Thurlow). [Leaflet.]

La conserva del pescado en los paises tropicales (Seale). [Translated for the Philippine Net and Braid Manufacturing Co. Inc., of Manila.]

BIOLOGICAL LABORATORY

Personnel.—The medical personnel of the Bureau of Science is in a seriously depleted condition. Dr. M. A. Barber, who succeeded Dr. E. L. Walker as chief of the biological laboratory, went on leave in January, 1915, and resigned to accept a position with the Rockefeller International Health Commission, and Dr. John A. Johnston has been acting in his stead. During the absence of the Director of the Bureau, Doctor Johnston was Acting Director. Since 1911 there have been three resignations from the position of chief bacteriologist, the men leaving to accept what to them were more attractive positions. The personnel has been more and more reduced on account of resignations, on account of a reduction of the number and salaries of positions by the legislature, and on account of inability to fill vacancies promptly. Dr. J. D. Jungmann, in charge of the clinical laboratory at the Philippine General Hospital, was transferred to the Bureau of Health on January 1, 1915. Doctor Johnston went on leave in October, 1915, and since that time the responsibility for the work has been divided. Dr. Otto Schöbl went on leave in March and has been serving temporarily with the State Quarantine Service in New York, assisting in the detection of cholera carriers. He will sail on February 5, 1916, from San Francisco on the return trip to Manila. Dr. Charles E. Gabel was appointed assistant bacteriologist, and arrived here from the United States on June 19. Dr. H. W. Wade, formerly a bacteriologist of Charity Hospital, New Orleans, has been appointed bacteriologist and pathologist and will sail from San Francisco on January 1, 1916.

Routine.—In coöperation with the Philippine Health Service, by locating many of the sources of infectious diseases, we have been able to avoid serious epidemics, such as those of plague, cholera, typhoid, and dysentery, which have occurred in former years. Since the first two months of the year there has not been an unusual number of fæces examinations for cholera. It is impossible to say how the necessary bacteriological laboratory work could have been cared for during the past year, if there had been a serious epidemic. With so many resignations the Bureau would have been unable to perform the routine examinations requested by the Bureau of Health except for the faithful performance of much overtime work by the junior members of the staff. In former years the Bureau of Science had sufficient personnel properly to combat any epidemic that might arise, and when epidemics were under control the biological employees were able to investigate the diseases of the Archipelago. As a result of such investigations, diseases that were formerly formidable are now controlled with little difficulty. Notably among such is entamœbic dysentery. Also, through the diagnostic analyses of this institution it was discovered that the spread of cholera frequently and generally was through carriers rather than by contact with those who succumbed to the disease. During the past year numerous specimens were examined in a systematic effort to eliminate "carriers" from among persons engaged in handling foods. Each sample was examined for the presence of cholera and typhoid organisms as well as for entamœbæ and other intestinal parasites. Among the latter were found chiefly *Ascaris, Trichuris, Oxyuris, Strongyloides,* and hookworm. By such methods people who consciously or unconsciously harbored infectious material were made aware of its presence, and the public was protected from contamination. These procedures help to prevent epidemics and are reducing the large percentages of cases of intestinal parasitism. In October the examinations showed many throat swabs positive for diphtheria. The number of diphtheria carriers increased, as is usually the case before an outbreak of an epidemic. However, by stringent sanitary measures, which necessitated the examination of a large number of contacts and a great deal of overtime work on the part of employees, the outbreak was aborted, and no serious epidemic resulted. Besides the various routine tests for pathogenic organisms, other examinations were made. Mineral and other waters and milk were examined bacteriologically. The United States Hygienic Laboratory phenol coefficient test was applied to a number of disinfectants. The diagnostic work imposed upon the Bureau of Science by law and carried on during the year and made during the fiscal year 1914 is given in parallel columns in the following table:

Nature of examination.	Calendar year.	
	1914	1915
Waters	2,118	2,985
Gonococci	16,383	15,832
Widal test	599	5,168
Blood	6,398	27
Blood cultures	392	--------
Fæces	[a] 126,022	50,021
Leprosy	1,142	569
Plague	64	1
Rats for plague	[a] 113,337	79,298
Sputum	2,095	85
Urine	4,275	2
Rabies	35	21
Wassermann test	1,288	633
Histological examinations	181	473
Necropsy	412	117
Miscellaneous	1,649	9,989

[a] Suddenly increased by more than 50 per cent due to examination during an epidemic.

Sera and vaccines.—There has been little change in the production of these biological products. In 1911 there were three technical employees engaged in the preparation of sera and vaccines, whereas at the present time only the head employee of these remains. Some of the work accomplished in the past five years is shown by the following table:

Sera and vaccines prepared at the Bureau of Science.

	1911	1912	1913	1914	1915
Vaccine virus doses	3,451,436	2,148,186	2,237,672	1,295,625	1,875,901
Plague prophylactic cc			3,660		
Mallein doses	473	532	512	352	589
Diphtheria antitoxin units	234,000	639,000	983,000	169,500	50,000
Tetanus antitoxin do	610,250	1,821,700	1,406,500	1,756,000	7,482,000
Antiplague serum cc		60	9,540	7,860	3,600
Antidysentery serum do	780	1,950	2,280	830	2,200
Antityphoid serum do		52	3,000	960	2,910
Tuberculin:					
Human do	570	575	26	150	492
Bovine do	191	224	50	33	
Antistaphylococcus prophylactic, aureus and albus do	168		622		
Normal horse serum do	11,200	25,160	20,580	16,110	27,590
Typhoid vaccine do			1,760	1,876	1,911
Antigonococcus vaccine do		370	1,146		
Staphylococcus albus vaccine do			85	124	570
"B" coli vaccine ampules			135	5	
"A" serum for exophthalmic goiter cc	35				
"B" serum for exophthalmic goiter do	200				
Streptococcus vaccine ampules			82	19	
Antistreptococcus serum cc			2,070	30	1,830
Rabies vaccine doses	404	(a)	(a)	(a)	(a)
Tuberculin, bovine do				200	
Gonococcus vaccine ampules				814	2,350
Bacterial vaccine do				90	19
Antimeningococcic serum cc				2,970	4,920
Antisheep hæmolytic amboceptor units					7,500

[a] The Pasteur treatment for rabies is now practically entirely administered by the Bureau of Science, although we continue to send out rabies vaccine when it is requested. Thirty-four patients were treated at the Bureau of Science in 1912, 36 in 1913, 35 in 1914, and 112 from January 1 to December 31, 1915.

This table shows that as much work is accomplished now as formerly, and in some cases there is an increased demand for sera and vaccines. In order to accomplish so much, the employee has been compelled daily to work many hours overtime as well as on holidays and Sundays. Great difficulty was experienced in securing suitable horses for the production of diphtheria antitoxin, and since April the demand for the antitoxin has exceeded the supply. A number of inquiries relative to the Pasteur treatment were received, and an opportunity was given to correct several misunderstandings as to the nature of this treatment and its application, which may account for the increase in the number of cases treated during the year.

INVESTIGATION

The articles published in the Philippine Journal of Science are given on pages 45, 46. Other investigations have been made, but the reports are not yet published.

Cholera.—The investigation as to the mutability of the cholera vibrio has been continued by Doctor Schöbl at the New York Quarantine Station.

Malaria.—Doctor Barber and his assistants completed their study of malaria in the Philippines and conducted a survey as to the distribution of the commoner forms of anopheline mosquitoes and the distribution of malaria.

Leprosy.—The studies in the etiology and bacteriology of leprosy are still being continued. Experimental work with animals in two instances has given very promising results. The investigations of chaulmoogra oil with a view to obtaining an active principle or an allied body, begun last year in coöperation with the organic chemists, are being continued, and treatment with the various fractions and products that have been obtained from the crude oil are now being made available to patients at the Culion Leper Colony.

Plague.—The routine work of the examination of rats has been continued. But one case of rat plague has been discovered.

Pathology.—An important monograph on the pathology of plague was completed during the year.

Sanitary Health Commissions.—For many years it has been the policy in the conduct of the biological work of the Bureau of Science to send men to various provinces outside of Manila, when opportunity presented itself, for the study of disease. In 1909 an extensive expedition for the purpose of carrying on a complete medical survey in a typical provincial town was organized by the Bureau of Science and the Bureau of Health of the Philippine Government. The information obtained was thought to be typical of a Filipino town under normal conditions, and the results have been very helpful in the work of sanitation. During recent years, owing to the increases in routine work and the reduction of staff, less of this work has been done, whereas for the best interest of the Filipino people the work should have been extended. The health of the community can be greatly improved by a study of the geology and the bacteriology and chemistry of the water supply, the fruits and vegetables and other food of the people from a physiological standpoint, the insect pests, the general sanitary conditions, the animal parasites of the intestines, the examination of the blood with reference to fever parasites, as well as an examination to determine the prevalence of tuberculosis, beriberi, venereal and skin diseases, etc. The present Director of Health realizes the benefit to his work of an intense sanitary survey in the provinces. Sanitary commissions have been formed, and the work is being carried on in two towns. The Bureau of Science is coöperating and is responsible for the bacteriological work. It is proposed to extend the work as rapidly as funds will permit.

General.—Owing to resignations and the large number of routine tests, other lines of work have been handicapped. When the demand for examinations necessary to suppress infectious organisms is decreased, other sanitary measures should receive more attention. The bacteriological examination of foods and drugs will result in cleaner and more wholesome products. We have been able to establish definite chemical standards for our foods and drugs, and so in time we should also have definite bacteriological standards. Due to lack of personnel we are unable to test many substances that are examined bacteriologically in the United States. For example, the following indicates the nature and number of some such samples examined in the Denver Bacteriological Laboratory of the United States Department of Agriculture as given in the American Food Journal (1915), 5, September: Air, 5; butter, 45; butter-milk, 12; butter starter, lactic acid cultures, 7; candy, 71; cheese, 4; cornmeal, 60; cream, 253; figs, 4; gelatin, 82; starch, 5; wash water from hands of persons handling food, 6; wash water from tanks in creameries and bottling houses, 8.

SECTION OF BOTANY

Personnel.—The work has been very greatly restricted during the past year by depletion of the force. The chief botanist, Mr. E. D. Merrill, was away on leave of absence from April 4, 1915, until the close of the year, leaving but a single technical employee, Dr. W. H. Brown, in the section. During the part of the year that Mr. Merrill was in Manila, he continued as heretofore to render service in the University as associate professor of botany and head of the department. He also gave a special course of ten lectures on medical botany in the post-graduate medical course. At the opening of the school year 1915-16, Doctor Brown was detailed to the University to take over the classes formerly under the direction of Mr. Merrill, and this ultimately led to Doctor Brown's transfer to the University in July, under an arrangement by which he devoted one day per week to the Bureau of Science. The position of mycologist was filled by the appointment of Dr. Harry S. Yates, who reported for duty in August, 1915.

Exploration.—Comparatively little field work has been done during the past year, owing to the depleted force. The work has been done chiefly by Mr. Ramos, with the exception of one important collection made in Laguna Province, Luzon, by Mr. McGregor. Collections have been made by members of the Bureau staff in Batangas, Cavite, Cagayan, Bataan, Rizal, Laguna, and Sorsogon Provinces.

Mycology.—Fungi are inconspicuous plants, some species of which cause the most troublesome plant diseases, such as some of those of coffee, coconut, and tobacco. The study of fungi in the Bureau of Science consists of two lines, namely, systematic mycology and plant pathology. The first is concerned with the scientific name of the species and whether or not the same species is found in other countries. The second is the study of the effect of fungi upon the higher plants, especially cultivated ones, and the study thus becomes economic. Both are intimately connected, and a large amount of purely systematic work must be done before definite progress can be made in the more economic aspects of the question. That is, the mycologist must first know the name and systematic position of the organism he is considering, otherwise the economic work in other countries is not available to him. The effect of fungi upon animals is a large field that so far has been little touched upon in the Philippines.

The Bureau of Science has been carrying on systematic mycology for a number of years, and the herbarium contains a fairly complete representation of the named fungi known to occur in the Philippines, totaling several thousand specimens. The nucleus of an extra-Philippine collection has also been established by an exchange of duplicate material. In view of the fact that no large herbaria exist in this part of the world, this foreign material is essential for purposes of comparison; without it, it would be necessary to send a great part of our material to European specialists for identification. Hardly more than a beginning has been made in the study of the fungi of the Philippines. In spite of the relatively large amount of work already accomplished, the number of new species in all collections brought from the field is surprisingly large, and this is true even of collections made in regions supposed to be botanically well known. In developing the work in mycology, it is planned to continue the field work to build up the herbarium as rapidly as possible both by collection and by exchange.

In plant pathology very little has been done in the Philippines, although this subject is one of very great economic importance. It will become increasingly important with the development of agriculture in the Archipelago. It is probable that there now exist in the Archipelago many of the diseases of tropical plants known to be caused by specific fungi, and very likely there are special diseases caused by endemic, parasitic organisms. However, at the present time very few plant diseases are definitely known to occur in the Philippines, and in no single case has any careful and critical local investigation been made. We have one very destructive disease of the coffee; a few apparently not especially harmful diseases of the coconut, sugar cane, corn, rice, and tobacco; and a recently discovered, and apparently very serious, disease of citrus fruits. While some very serious plant diseases now occur in the Philippines, it seems to be well established that very many serious pests in other countries have never reached our Archipelago. To guard against the possible inadvertent introduction of destructive fungi from other countries, all imported stock should be carefully inspected by a competent, trained mycologist. Likewise all stock shipped out of the Philippines should be so inspected. The plans for the coming year include a general survey of the species of fungi known to produce disease in plants that are now known in the Philippines and a careful examination of cultivated plants whenever possible to detect as many of the pathogenic fungi as possible. In those cases where species are known we can simply apply the methods of control and eradication already perfected by mycologists in other countries. It is planned to investigate intensively new forms, which are expected to appear in the course of this campaign, especially if they appear to cause serious disease. In the meantime reorganization of the mycological collection is being pushed as rapidly as possible, species and host indices prepared, and material already on hand is being placed in the hands of specialists for study. In coöperation with one of the chemists of the Bureau, work is being done on the effects of molds on stored copra, a subject which has received little consideration, yet apparently is one of great economic importance.

Physiology.—Work similar to the extended discussion of the Philippine dipterocarp forests, the chief local source of building timbers, by W. H. Brown and D. M. Mathews, in the Philippine Journal of Science, Section A (1914), 9, Nos. 5 and 6, is to be continued in the near future on the pine forests of northern Luzon. Considerable progress has been made in a study of the water relations of certain plants, particular attention being given to the relative relations of absorption and evaporation under different conditions.

The field work on the distribution of plants on Mount Maquiling in relation to the environmental conditions has been completed. This work consisted in taking careful and continuous records of temperature, rainfall, humidity, wind, evaporation, and soil moisture in several different situations in a number of localities at various altitudes from the base to the summit of the mountain and relating these data to the rate of growth, size, number, and character of the trees or other plants found on the area. For comparative purposes similar work has been commenced on Mount Banahao. On the completion of this work many classes of vegetation can be directly correlated with climatic factors. Thus, by observing the natural vegetation of a given area, to a large degree, the nature of the climate and the agricultural use to which the region in question is adapted can be determined. The idea may be summed up in the determination of certain prevalent types of vegetation as the indicators of the value of the areas for agricultural purposes.

Herbarium.—During the absence of Mr. Merrill in the United States, current identifications of material for the Bureau of Forestry were made by Mr. Fénix, who was also responsible for the general care and arrangement of all original and duplicate material received. The work of Mr. Fénix in this difficult position has been excellent, and he has correctly made a high percentage of identifications. The European war has cut off many exchanges. In continuation of the exchanges and relations with specialists previously arranged, 9,130 duplicate botanical specimens have been distributed. Of these about 7,000 have been distributed in exchange, about 1,500 have been sent to specialists for study and report, and 648 have been identified, mounted, and turned over to the Bureau of Forestry for distribution to the various provincial forestry stations. Mounted sheets loaned to specialists for study number 439. Many duplicates from the collections accumulated during the past year, and several undistributed sets of older collections cannot be shipped now because of war conditions.

Philippine accessions.—Collections made by employees of the Bureau of Forestry were approximately the same in quantity as in the preceding year. Under the circumstances the increase in the herbarium has been satisfactory, although especially on account of the lack of personnel the number of Philippine plants added is less than for several past years and is 4,857. These have been received by collection, by gift, for identification, and by transmission from other departments of the Government. The important collections of Philippine material are:

Collections of employees of the Bureau of Science	2,348
Collections of employees of the Bureau of Forestry	1,551
Miscellaneous collections of Messrs. Wester, Octubre, Sandkuhl, Topping, Baker, Eskridge, Gates, and Vanoverbergh, and of Mrs. Clemens	958

Foreign accessions.—The extra-Philippine material received, consisting of 6,356 specimens from all sources, has been poisoned and mounted and will be distributed into the herbarium. The large Formosan collection, purchased from Abbé Faurie, is of especial value for purposes of comparison. Likewise a valuable lot of material, very rich in cotypes, was received from the Royal Botanic Garden in Calcutta.

Foreign accessions during the past year were as follows:

P. Magnus, miscellaneous fungi in exchange	95
Mrs. M. S. Clemens, Chinese plants for identification	2,404
P. Nelson, Guam plants for identification	43
Native collector, Sarawak, Bornean plants for identification	216
Dr. Fred Baker, Malayan ferns for identification	22
Dr. J. H. Maiden, Sydney Botanical Garden, Australian plants in exchange	99
Rev. C. King, New Guinea plants for identification	78
Zenker, Kamerun plants, T. O. Weigel, exchange	98
A. F. G. Kerr, Siamese plants in exchange	209
I. H. Burkill, Singapore, Malayan plants in exchange	226
R. Kanehira, Polynesian plants for identification	91
T. Kawakami, Formosan plants in exchange	145
Calcutta Botanic Garden, Malay Peninsula plants in exchange	354
U. S. Department of Agriculture, Meyer's Chinese plants in exchange	139
Abbé U. Faurie, Formosan plants, purchased	2,090
Dr. Fred Baker, Formosan plants, presented	47

Important extra-Philippine collections on hand urgently in need of study are the Robinson Amboina collection of approximately 1,200 numbers; about 3,000 numbers from Borneo, secured through the courtesy of Mr. J. C. Moulton, of the Sarawak Museum; and small collections from Polynesia and New Guinea.

Arrangements have been made to have the extensive Chinese collections made by Mrs. Clemens, totaling nearly 4,000 numbers, studied and reported on by European specialists. Preliminary work has been done on the Robinson Amboina collection, and I hope the work can be completed during the present year.

Total accessions.—The specimens added from all sources to date increase the grand total of the herbarium to 160,354 mounted specimens, of which 92,357 are Philippine and 67,997 are extra-Philippine. An especially valuable lot of material from Mount Kinabalu, Borneo, was received from Mrs. Clemens just at the end of the year; it is not included in the totals, as there was no time to prepare it.

Publications.—A list of the papers that have been published in Section C, Botany, of the Philippine Journal of Science is given on page 47.

SECTION OF ICHTHYOLOGY

Fish culture carried on by the Bureau of Science has progressed steadily. The black bass, *Mycropterus salmoides*, brought originally from the United States in 1907, have increased in a satisfactory manner both in Baguio Lake and in the spawning pond built near the Bureau of Science. Lake Lanao was stocked last year with fry from Baguio, and in October bass fry from the Bureau of Science pond were planted in a seldom-frequented portion of Laguna de Bay where it is believed they will thrive. The stocking of these lakes with black bass will mean a considerable increase of the available food supply of the respective communities and will be a factor in keeping them free from mosquitoes. Other lakes will be stocked from time to time. The Bureau of Science also has distributed many mosquito fish to those who have applied. There is still an ample stock ready for distribution. The economic fishery industries of the Islands have been stimulated in many ways, and instruction regarding the construction of fish ponds and other information have been given. The fish expert was absent on leave in the United States from May 16 to December 3, 1915, and consequently somewhat less work has been accomplished than in previous years. The services of Mr. A. L. Day, of the University of the Philippines, were secured during the period for carrying on the routine work.

The fish expert was detailed on December 18, 1915, further to study Philippine pearl fisheries and to coöperate with the Governor of the Department of Mindanao and Sulu in proposing an act regulating the fishing for shells of marine mollusks in waters of the Philippine Islands. An act regulating the sponge fisheries in the Philippine Islands was prepared. Both of these proposed acts have been or soon will be presented to the legislature and if passed will be satisfactory to the fishing concerns and fishermen themselves. They will also be comparatively easy to enforce.

SECTION OF ORNITHOLOGY AND TAXIDERMY

The efforts of the section of ornithology and taxidermy now are mainly devoted to economic ornithology; that is, the study of the feeding habits of birds for the purpose of determining the beneficial and the injurious species. The most important part of the study of food habits includes the field work of collecting specimens and the subsequent careful examination of the stomach contents. The largest single collection was made in Paete, Laguna, especially selected because it is in the center of a large rice-growing area. Over 500 birds' stomachs have been examined, and the results have been recorded on cards. This number of specimens scattered unevenly among several hundred species does not result in many specimens of any one species; consequently there are not enough records for any one species to warrant generalizations as to its food. However, enough work has been done to show its importance and to indicate that unexpected interrelations of organisms will be discovered. A few examples are here given to show the kind of results that may be expected from the intensified and completed study.

One of the most abundant birds about fresh water swamps and grassy borders of lakes is the moorhen, *Gallinula chloropus* Linnæus. The stomach of a moorhen killed at Paete, Laguna, on July 3, 1915, contained 19 larvæ of a tabanid fly that may very easily be *Tabanus striatus* Fabricius, the most prevalent horsefly of the Philippines. Other specimens of the moorhen also had eaten tabanid larvæ. Mitzmain found that this species plays "a rôle in the transmission of surra." [See Philippine Journal of Science, Section B (1913), 8, 223–229.] Therefore it seems probable that the moorhen is an important agent in preventing surra from becoming an uncontrolable epidemic.

The only species of grebe (hell-diver or dabchick) inhabiting the Philippine Islands is *Tachybaptus philippensis* (Bonnaterre). Examination of five stomachs of the Philippine grebe showed that two had eaten small shrimps of commercial value; two had eaten specimens of a water bug (Belastomidæ) that may be injurious to fish fry; and one had eaten a beetle, *Cosmopolitus sordidus* Germar, that is injurious to banana-plant roots. This is sufficient to show the nature of the field for investigation offered in the study of the food of this species of bird. The grebe may be injurious to the shrimp fishermen, but on the other hand it is possible that the water bug which it eats is injurious to the young fishes. Therefore further study is necessary before this bird can be classified as injurious or beneficial.

These two illustrations show the importance of including all species of birds in the food investigation. Birds that are least expected to be of economic importance may prove to be highly beneficial or injurious.

In connection with the food investigation a blank has been prepared asking for information on the food habits of birds. This blank will be sent to members of the Agricultural Congress for the purpose of obtaining data as to what birds are injurious or beneficial to the farmer in various provinces. A circular letter has been printed to be sent with the blanks. The president of the Congress has approved this plan and promised the co-operation of the members.

Bureau of Science press bulletin No. 32, which was distributed September 23, 1914, has been revised and illustrated with small cuts of some Philippine birds. This is issued as a 14-page pamphlet with the title Birds in their Economic Relation to Man. The pamphlet is intended for distribution in the Philippine Islands in order to call attention to the very practical value of birds as protectors of forests, crops, etc.

Miscellaneous work was carried on as follows: Commercial taxidermic work such as mounting specimens of birds and fruit bats; the sale of scientific specimens to collectors in the United States; the dispatch of six cases of mounted birds for exhibition at the Northern Luzon Fair at Baguio; 500 numbers of plant specimens collected for the section of botany and for identification of food of birds; a series of rat specimens sent to the United States National Museum for identification in order to determine the host of the flea responsible for the transmission of plague; birds sent to the United States National Museum for identification; etc. Specimens have been gradually added to the collection of birds, and new or rare species have been reported.

SECTION OF ENTOMOLOGY

There was no appropriation for an entomologist; consequently none has been on duty during the year, and all the work accomplished by this section has been done under the supervision of the ornithologist. The regular stock of silkworms has been carried through the year. Those who have applied for silkworms have been informed that if they have a sufficient number of mulberry trees under cultivation to provide food for the silkworms, the Bureau of Science will be glad to furnish eggs with which to start. Eggs and cocoons have been supplied to those who were prepared to raise them, and instructions in the care of the worms have been given to several persons who wished to establish silk farms.

The production of silk is well suited to the people and the conditions in the Philippine Islands. The many years' work at the Bureau of Science has fully demonstrated that silk can be produced, but it is not to be expected that under present conditions the desired growth of the industry will result. The necessity for demonstrators to carry on this work is pointed out on page 54.

Efforts are being made again to introduce the eri silkworm, which feeds on the leaves of the castor plant. The cloth woven from the silk of this silkworm is believed to be of superior quality. However, it is to be remembered that the silk of the ordinary silkworm is a well-known product with a market value, while eri silk is little more than a curiosity, which even if produced in quantity would require time and money to introduce to the world.

Dr. R. P. Cowles, of the University of the Philippines, has taken advantage of the facilities at the Bureau of Science in order to carry on some experiments in breeding silkworms. There is a large amount of practical work as to the best races of silkworms that should be introduced and crossed with our own in order to retain the present stock in vigor and free from danger of disease.

CHEMICAL LABORATORY

Personnel.—See division of general, inorganic, and physical chemistry and division of organic chemistry.

INVESTIGATION

The effect of the European war has been greatly to increase the burden of work on the chemical laboratory of the Bureau of Science. Many supplies have been cut off from the Philippines by the inability of certain countries to keep up their manufacturing industries and by the tremendously increased and continually increasing freight rates. In connection with its regular routine work the chemical laboratory has been called upon to solve problems that required much research ability. For example, new bleaching methods have been made possible to several enterprises. Many industries have been improved and adapted to war conditions. In addition to the regular requested examinations the chemists carry on as many investigations of industrial subjects as time will permit. I have frequently pointed out the importance of determining the most efficient methods for treating certain commodities, discovering uses for hitherto unknown, and new uses for already useful, materials, etc. The following are some of the investigations that have contributed and are contributing to these ends:

The properties and some of the uses of oils produced from lumbang, kapoc, cashew, castor bean, tree cotton seed, physic nut, pili, calumpang, and cato have been determined. The drying qualities of the lumbang oils have been examined. Further uses for some of these oils and their properties when hardened by reduction with hydrogen are now being investigated. Chaulmoogra oil and its administration in the treatment of leprosy is being coöperatively studied by the organic chemists and the biological experts of the Bureau of Science. In attempts to treat leprosy, great variation was found in the efficiency of various purchases of chaulmoogra oil and in the degree of tolerance that patients exhibited toward different shipments. Frequently a crude oil appeared to have greater curative properties than a pure oil. Commercial chaulmoogra oil is not obtained from a single species of tree, but from representatives of several closely allied genera of the Flacourtiaceæ. In view of these facts I thought there might be an active principle in chaulmoogra oil or that one member of this family might be wholly responsible for the curative properties and assigned men to the experimental work. It is interesting to note that the Philippine Islands possess several representatives of the Flacourtiaceæ: for example, *Pangium edule* Reinwardt and *Hydnocarpus alcalæ* C. de Candolle. In order to get accurate information and to solve some of the intricate questions involved, a few of the commercial oils have been studied, the study of the product of the former tree is now under way, and one of the latter will be undertaken as soon as material can be secured.

A complete survey of the medicinal plants of the Islands, together with an investigation of the chemical and physiological properties of their constituents, should be carried on by organic chemists and botanists in coöperation, and I hope to arrange for this work very soon.

Many oils available for the perfume industry have received attention. This work has resulted in the improvement of some of the old methods, making possible a better grade of ylang-ylang oil and the production of champaca, the finest perfume of the

Islands, and will be the basis for further industries in the Philippine Islands. One year ago Doctor Brill began work on gardenia, but owing to the lack of material it was discontinued. It is expected that sufficient flowers will be available this year to carry on the work. At present all perfumes sold as gardenia are artificially prepared, and there may be an excellent opportunity for the cultivation of the flowers in these Islands. There are many other flowers that are available for cultivation for perfumery in the Archipelago. These will receive study by the Bureau whenever quantities large enough to justify an investigation can be obtained.

Beriberi has been extensively studied by the Bureau of Science in the past, and many contributions with regard to the etiology of this disease have been published in the Philippine Journal of Science. Active study of this disease is not now in progress owing to lack of men. However, quantities of tiqui-tiqui extract for free distribution through the Bureau of Health under Act No. 2376 for the alleviation of infantile beriberi are now being prepared, as pointed out on page 10.

An article on papain shows conclusively that gum made in the Philippines is equal, if not superior, both regarding color and activity, to any now on the world's market. It is a good commercial proposition, provided a limited market is not flooded.

As material for paper becomes scarcer and more difficult to procure, it is increasingly apparent that the Philippine Islands are to play a larger part in furnishing a supply of the raw material. The Bureau of Science has investigated the suitability of the waste from abacá, or Manila hemp, cogon grass, and various other substances for paper pulp. Investigations by the Bureau have demonstrated that bamboo can be made into a high-grade pulp and that it will help to overcome the scarcity of the raw material for paper. So much interest has been shown that sales of the number of the Philippine Journal of Science containing information on this subject have exhausted the stock. A reprint of the article on Philippine fibers and fibrous substances and their suitability for paper making with regard to bamboo pulp has been made.

The Bureau of Science will very soon publish a preliminary article on the destructive distillation of waste woods of various kinds and the products obtained as a result of this distillation. This investigation should assure the utilization of the waste wood of the Islands. The resins and resinous woods have been investigated, and it has been shown that these are very similar to those from the same types of trees in the United States and

Europe. The economic possibilities of the mangrove swamps of the Philippines have been studied by the Bureau of Science and the results published. It was shown that there are areas of workable swamps yielding high-grade tanning materials capable of producing yearly a minimum of 1,500 metric tons of extract. Some of the waste wood could be used for piles. This new work provides for the utilization of the remainder of the waste wood and should insure the exploitation of the mangrove swamps.

The many unique and characteristic foodstuffs used by the Filipino population, as well as the citrus and other fruits, have received attention. An article on the various native vegetables used for food is almost ready for publication. The nutritive value of these products is now known and is available for studying dietary questions of great practical importance. All varieties of canned milks entering the Islands, as well as fresh cows', goats', and carabaos' milks, have been included in this study. As soon as personnel is available, I desire that a series of experiments be made for the study of nutrition as related to the Tropics. Such a study should throw light on the present confusion of ideas held with regard to the food necessary for sustenance in a tropical climate and should assist in controlling and reducing the high infant mortality. The importance of this work can be hardly overestimated.

The Philippine Islands export more copra than any other country. Many investigations have been and are being made and published by the Bureau of Science on coconut products, including the water relation of the coconut palm, the mold and bacterial causes of rancidity, the decrease in the oil content of the nut on account of its unripe condition and the locality in which it is grown, methods of drying, insect pests and preventive measures, effect of feeding copra cake to cattle and hogs, and the deterioration of copra during transportation. Not only is there loss in the copra or oil, brought about by picking green nuts, but insufficiently dried copra deteriorates on account of the multiplication of bacteria and molds thereon, and the oil that is expressed therefrom is dark-colored. No radical changes should be made in the methods of drying copra until the best methods to be adopted have been established. The work on coconut products, now being carried on in the Bureau of Science, is directed toward improved modifications of existing methods of drying so as to produce a copra that shall be white, sufficiently dry, and proof against molds. Such a product will yield an oil suitable for edible purposes and will have a high market price. Work is also in progress on a commercial method for the production of a good grade of oil from the uncured nuts, thus avoiding the intervening step of drying the coconut meat. Simply by burning coconut shells instead of husk, smoke and a consequent black product can be avoided. The use of husk as fuel should be avoided for the further reason that the husk fiber is much more valuable for other purposes, such as the manufacture of brushes, doormats, etc. Many inquiries have been received from the United States and Hawaii relative to copra and copra-drying methods in the Philippines.

A great deal of work has been done on the sugar and alcohol industries of the Philippine Islands. In completed investigations it is shown that a greater profit is possible by making the sugar contained in palm juices into commercial sugar than by converting it into ordinary alcohol. Methods for handling the juices, so as to overcome the difficulties encountered in making sugar, have been determined and published. The manufacture of Philippine brandy may be more profitable than the manufacture of sugar. For a number of years the properties of coco and palm brandies have been under investigation. The effects of aging these brandies in wooden casks are being studied by analyzing the liquors at the end of each six-month period. The results, which will soon be ready for publication, indicate the changes taking place in these liquors under certain conditions and the best condition for bringing about beneficial ones.

Much molasses is being used for the production of alcohol. Considerable difficulty is being encountered by the manufacturers of alcohol from molasses in obtaining uniformly good results. The Bureau of Science should assist in the establishment of methods that will insure maximum yields of alcohol in all cases. There is no chemist available for this work.

The various methods of preparing sugar in the Islands have been studied, and it has been shown that in many cases a gain of sugar would result by allowing the cane to ripen, by using more nearly complete extraction, and by exercising greater care in handling the juices than is the common practice. The Bureau of Science Iloilo sugar laboratory, since it was established, has been eagerly used by both producers and dealers, who avail themselves of umpire polariscopic analyses in cases of dispute and as a basis for valuation. There has been opportunity in both Iloilo and Manila for a large amount of instruction in regard to the planting and harvesting of cane and the more perfect recovery of the sugar.

The Bureau of Science has carried on an investigation of tanning methods in the Philippine Islands. It consists of practical work under conditions as they prevail in Philippine tanneries and shows how local methods may be greatly improved and that the product of the tanneries could be increased in quality and volume with very little increase in the capital invested. The Bureau of Science has produced leather free from the disagreeable odor characteristic of Philippine leather and equal in quality to the imported product. Furthermore we have successfully and satisfactorily tanned thick carabao hides, twice as thick as ordinary cattle hides, whereas by the Filipino processes carabao hides are tanned only with difficulty after they have been split. Well-prepared carabao leather is exceedingly beautiful and will find exceptional sale for the manufacture of trunks, suitcases, book bindings, etc. During the coming year we plan to extend the work to include practical demonstrations to tanners of the proper methods and to make a series of tests of several kinds of native barks, which are possibly adapted to the purpose. If the tanners will follow the process used by the Bureau of Science, the following yearly losses can be avoided:

	Pesos.
Due to incomplete tanning and partial putrefaction of the leather during the process, which constitutes a loss of 32 per cent of the weight of the finished product	576,000
Due to the decreased value of the inferior product as compared with imported leather	450,000
Due to waste and uneconomical tanning material	50,000
Total	1,076,000

The actual value of the leather tanned in the Philippine Islands is about ₱1,800,000 per annum, and the importation of leather and its manufactured products for the year 1914 amounted to ₱3,115,648. This shows the importance of the tanning industry in the Philippines and that due to its crude methods there is an annual loss of over ₱1,000,000.

A beginning has been made in an effort to safeguard the water supplies of the Philippine Islands. During the year the Bureau of Science has performed about 200 analyses of water from artesian wells, dug wells, reservoirs, springs, etc., which makes a total of about 2,000 water analyses on file in this Bureau. The work presented in a preliminary paper, consisting of 40 pages on the water supplies of the Philippine Islands by Cox, Heise, and Gana, has been continued. The Bureau of Science has made possible the differentiation between good and bad waters, not only with respect to potability, but also with regard to suitability for technical and industrial purposes. Work has been and is being carried on to determine certain factors influencing the chlorination treatment of water as applied to Manila and other municipal supplies and on some of the analytical problems connected with such determination. A complete general study of the Manila city water supplies is about finished. In spite of this our knowledge of the quality and quantity of available Philippine water supplies is insufficient to enable us to reserve the most valuable springs. The time has come for more careful safe-guarding of the water supplies of the Philippine Islands. It seems to me that a duty the Government owes to future generations is to provide adequate water supplies now. A special fund for this investigation was recommended in my appropriation estimate, and I had hoped that the work might be pushed to completion. The laboratory methods of water analyses have been adapted and revised in an effort to secure the greatest amount of information from them. A field reconnaissance of water supplies has made fair progress. If we are able to perform the necessary and desired coöperative work with the sanitary commissions and investigate the municipal wells and medicinal and thermal springs, we shall be able to specify the normal constituents of waters and to develop standards of purity, both chemically and bacteriologically, for different localities. When this has been done, the Government can make reservations of suitable areas from the public domain surrounding springs of value.

The failure of the service pipes of the Baguio water-supply system led to an investigation that demonstrated the existence of corrosion due to the high acidity of the water. Methods for correcting the excess acidity were proposed and are soon to be put into use.

A very important investigation of Philippine clays to determine their suitability for the manufacture of paving brick, roofing tile, sewer pipe, etc., is under way. It is hoped that we shall be able to find material for making a light-weight roofing tile, which can be supported upon a light and cheap structure to take the place of nipa roofing. In this way destructive fires, which frequently occur in towns throughout the Philippine Islands, can be reduced in number and extent.

In 1913 the Bureau of Science tested and analyzed the different roofing materials submitted in the contest for a cheap substitute for nipa roofing. We were thoroughly convinced that by far the most satisfactory method for producing an inexpensive roofing would be the fire-proofing of nipa itself. The ordinary fire-proofing methods used gave promising results. This problem is of sufficient economic importance to justify investigation as soon as time and opportunity will permit. The literature relating to fire protection is being collected, and that on hand should enable us to develop a local standard promptly.

The correct classification of the climbing palms, which produce the commercial rattans of the Philippines, depends on a combination of characters that cannot be determined from the data and collection available. The many species in the Philippines belong to three genera. Some of these are small, the canes being 1 centimeter or less in diameter, while others have canes up to 5 centimeters or more in diameter. There is a great variation in the character of the rattans. The stripped material of some species is very tough, has great tensile strength, does not readily break in bending, and can be readily bleached. The rattans are notoriously difficult to classify from a botanical standpoint, because it is exceedingly difficult to prepare good herbarium specimens. In spite of this the Director of Forestry has at the suggestion of this Bureau issued a circular letter to all forest officers in charge of stations to send in proper material for this work. When the material arrives, further effort will be made to determine the differences that control the commercial product and to devise means by which well-bleached, or white, split rattan of standard commercial lengths can be supplied from Philippine materials.

Frequently maguey and other fibers are cheaper than abacá (Manila hemp) and are used as diluents in so-called Manila hemp rope and similar materials. Color tests to distinguish between abacá and other fibers have been developed. A satisfactory method of staining has been devised, which gives distinctive colors, such as golden yellow for abacá and pink for maguey.

The present method of extracting the fiber from the petiole of the buri palm, used for buntal hats, is slow and expensive. [See Bureau of Education Bulletin (1910), No. 33, pp. 33–41.] The Bureau of Science has undertaken to improve this method with the result that the quantity of fiber extracted in a given time by one individual is several times larger than the quantity obtained by the method at present in use. The results are being prepared for publication.

According to the Bureau of Customs 10,520,233 kilograms of galvanized iron, valued at ₱1,540,622 and used as a roofing and building material in the form of corrugated sheets, were imported during 1914. From 80 to 90 per cent of this is from the United States. Not all importations have given satisfactory results, and the Bureau of Science is investigating the efficiency of various kinds of galvanized iron and the factors that affect their corrosion and expects to carry the investigation at least far enough to enable the Government to purchase all materials of construction according to specified requirements that will guarantee satisfactory service. (See Standardization, p. 9.) New methods of analysis and stripping of galvanized iron and tin plate have been developed, some of which may have extensive commercial application.

In addition to the work outlined on page 25 of my last report, extensive investigations of paint materials and various protective coatings for iron and steel and for metallic structures are being planned and are in progress, the Bureau of Public Works coöperating with both money and materials. The work will include a study of the effect of various additions, chiefly Philippine oils, to paint vehicles and an investigation of various types of rust-inhibitive coatings, with a view toward finding the best protection for metals under tropical conditions.

The publications of this laboratory are included under the heading Philippine Journal of Science, Section A. (See p. 45.)

The routine work of the laboratory has not changed materially and is of the same general character as described last year.

DIVISION OF GENERAL, INORGANIC, AND PHYSICAL CHEMISTRY

Personnel.—Mr. R. R. Williams, chief of the division, went on leave in February and resigned, effective April 16, 1915, to accept a position in the Bureau of Chemistry of the United States Department of Agriculture, Washington, D. C. Mr. T. Dar Juan was appointed chief analytical chemist on February 15, 1915. Mr. R. H. Aguilar was appointed on February 1, 1915. Mr. F. D. Reyes, who resigned on April 6, 1914, was reinstated on November 1, 1915. Owing to an insufficient personnel to care for all of the work, employees, including a graduate student of the University of the Philippines, were taken on as temporary assistants at various times. Besides the research work indicated above, the inorganic chemists have been busy with the analysis of a large number of samples. Of these over 8,000 have been received and reported upon during the year. For a period of several years before my appointment as Acting Director and Director of the Bureau of Science I was in direct charge of this work; therefore the capabilities of each employee are pretty accurately known to me. In view of this fact and the necessity for economy, I decided not to appoint a regular chief of division at present, but to keep in close personal touch with the demands on the division and to place the work under three superintendents of sections who would report directly to me, as follows:

1. Section of analytical chemistry:
   Messrs. T. Dar Juan, A. S. Argüelles, F. D. Reyes, F. Peña, and G. Rantaso.
2. Section of weights, measures, water analysis, and physical chemistry:
   Messrs. G. W. Heise, V. Q. Gana, R. H. Aguilar, and E. Ignacio.
3. Section of physical and mechanical testing:
   Dr. J. C. Witt and Messrs. A. E. W. King and F. R. Ycasiano.

The work of the various sections, as specified in my memorandum order, is as follows:

Section of analytical chemistry:
Rocks, minerals, ores, slags, clays, limes; plasters, soils, fertilizers, etc.; iron and steel; metals and alloys; pigments and mixed paints, including vehicles; fuels, including calorific value; gas; and inorganic chemicals and other inorganic analyses, except fire assays.

Section of weights, measures, water analysis, and physical chemistry:
Waters, sewage, corrosion; weights and measures; and instruments and apparatus such as thermometers, pyrometers, microscopes, refractometers, and other physical and chemical apparatus.

Section of physical and mechanical testing:
Cements, aggregates; iron and steel; road materials; tars, asphalts, and bitumens; stones, twines, ropes, wires, khaki cloths, fuels, etc.; and the standardization of other classes of supplies.

Routine.—The routine work accomplished by the division of general, inorganic, and physical chemistry is shown in the following classified summary:

Nature of material or work.	1914	1915
Metals and alloys	51	44
Rocks, minerals, natural pigments, and similar substances	--------	15
Clays, shales, limestones, limes, wall plasters, cements, and slags	11	5
Fertilizers	14	34
Soils and similar substances	42	365
Coal analyses	22	50
Calorimetric tests of fuel	7	34
Waters	208	201
Crude chemical and miscellaneous analyses	88	135
Standard solutions	30	20
Physical tests of wire, twine, fiber, textile, paper, and similar articles	31	32
Cements	6,817	6,716
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	86	203
Standardization of road materials	15	71
Standardization of units of measures:		
Lengths	171	60
Capacities	312	121
Weights	776	31
Miscellaneous	41	22

Mr. King has given the course of instruction in cement testing offered by the College of Engineering of the University of the Philippines. From time to time the division also has assisted the division of mines with the assays for gold and silver.

DIVISION OF ORGANIC CHEMISTRY

Personnel.—The year was begun with Dr. D. S. Pratt, chief of the division, Dr. H. C. Brill, and Messrs. L. W. Thurlow, A. H. Wells, F. Agcaoili, Lorenzo de Arego, and Hermenegildo Taguibao. The resignation of Doctor Pratt, who had been absent on leave since May 15, 1914, was accepted during the year. Dr. H. C. Brill has acted as chief of the division throughout the year. Mr. de Arego resigned, effective June 3, 1915. Mr. Thurlow, who is regularly stationed at Iloilo, went on leave to the United States on May 15 and returned to Manila December 3, 1915. During the absence of Mr. Thurlow the work at the Iloilo sugar laboratory was cared for by the detail of Mr. Wells and of Mr. Agcaoili during alternate periods. September 28, 1915, Mr. Wells left for the United States on vacation leave. Due to resignations and absences on leave the division has been reduced to an average of only about three men, which has made it very difficult to keep the work going. On account of this shortage Mr. Fr. W. C. Hauch was temporarily employed from February 20 to October 15, 1915. Mr. H. O. Parker, a graduate of Wabash College and for one year a graduate student at the University of Pittsburg and for three years a graduate student at Princeton University, arrived from the United States and began duty on August 1, 1915. Even yet the division is somewhat short-handed.

Routine.—One employee of the Bureau of Science is a member of the Food and Drug Board and meets with this Board to render decisions on all questions concerning the violation of the Food and Drugs Act. As imposed by law the organic chemists have continued to examine foods and drinks for adulteration or misbranding under Act No. 1655 and medicines and medical appliances examined for violation of Act No. 2342 in an effort to allow only pure foods, good general commodities, nonfraudulent medicines and therapeutic appliances and practices, and legitimate advertising of the same to be circulated in the various avenues of trade of the Philippine Islands. The war has decreased the imports to the Islands from Europe by cutting off our regular supplies from the belligerent countries, but it has brought about a larger influx of food supply from China and Japan, and these should have a much closer inspection than our former supplies from Europe. The Legislature very wisely passed an amendment to the Food and Drugs Act, requiring that all food samples have the quantity of the contents stated on the label. The enforcement of this amendment has been postponed until foreign manufacturers could be informed of its provisions. However, it is now in effect. The results of the war and the new legislation are very much to increase the burden of work of this branch of the Bureau of Science. The Legislature has shown its interest in this work by the judicious laws that it has passed, and the personnel for the enforcement of the laws should be provided as requested in my appropriation estimate. Besides foods, drinks, and drugs, all oils, sugar and sugar products, toxicological and clinical specimens, opium, prohibited alkaloids, commercial and miscellaneous organic samples, and work connected with legal cases form a part of the regular routine work of the division of organic chemistry. Several thousand such samples have been examined during the year as shown by the following classified summary:

Nature of sample.	Examined under Acts 1655 and 2342.	Violation of Act 1665.	Government work.	Private work.	Total samples submitted.	
					1915	1914
Alcoholic liquors	12	10	34	4	38	16
Cereals and cereal products	2,059	7	2,083	17	2,100	57
Clinical examinations other than urines			18	3	21	42
Commercial and miscellaneous			37	53	90	123
Condiments	5	5	4	5	9	11
Dairy products	93	22	97	32	129	66
Drugs and medicines	[a]117	68	117	8	125	33
Essences	3	3	3	12	15	33
Fruits and fruit products	29	23	32	8	40	11
Meats and meat products	82	19	82		82	19
Mineral and vegetable oils			31	8	39	23
Nonalcoholic drinks	113	30	115	2	117	46
Opium and legal cases			44		44	44
Papers and textiles			114	2	116	109
Raw sugar and sugar cane			69	157	226	308
Sugar products			28	11	39	2
Urines			129	48	117	316
Vegetables	144	35	242	1	243	35
Total	2,657	222	3,279	371	3,650	1,294

[a] Sixty-seven were in violation of Act No. 2342.

The large number of examinations of cereal products is due to the campaign carried on by the Philippine Health Service and the Bureau of Science in conjunction with the Board of Food and Drug Inspection against the use of saccharine. The use of saccharine as a sweetening agent for soft drinks was rather general for a short period, and there was an inclination on the part of bakers to use it. An interesting result of this campaign was that in no case was any sample of bakery product found to be adulterated with saccharine. Only prompt action prevented its use from becoming more widespread.

Iloilo sugar laboratory.—During the year 3,560 samples of sugar were polarized at the Iloilo sugar laboratory. This shows the eagerness with which both producers and dealers avail themselves of umpire polariscopic analysis in case of dispute and as a basis for valuation. Through the Iloilo sugar laboratory we have been able to give instruction with regard to mill practice and more perfect recovery of sugar. As much assistance as possible in many factories has been given in order to secure the best results with the facilities at hand.

My recommendations with regard to the extension of the work of the Iloilo sugar laboratory are made separately on page 53.

DIVISION OF MINES

Personnel.—Mr. Wallace E. Pratt, chief of the division of mines, after some five and one-half years of continuous service, was granted leave of absence with permission to visit the United States and left on the July transport for San Francisco. In order that he might accept a Yale fellowship in economic geology and spend six months in study, which will greatly increase his efficiency in the Philippine Islands, I have extended his leave of absence, without pay, until July, 1916. Mr. V. E. Lednicky has been acting chief of the division during the absence of Mr. Pratt. Mr. John P. Goldsberry has been appointed a geologist in the Bureau of Science; he sailed from San Francisco on December 18 and should be ready for duty in January. The division of mines has been seriously handicapped by a small staff during the past year, but an attempt has been made to handle all routine work presented. With the assistance of men in other divisions this has been accomplished without serious confusion.

Routine.—A greatly increased number of consultations have been held, and during the year 460 assays, 29 bullion smeltings, and 266 placer weighings have been performed. Two milling and cyanide tests also were made. All of this work shows a marked increase over the previous year, demonstrates the assistance which the Bureau of Science can render to those interested in mining, and indicates a growing confidence on the part of the mining men. The employees in the division of general, inorganic, and physical chemistry have rendered valuable assistance with the assay work from time to time. A new assay balance with the greatest accuracy obtainable has been ordered and will be the standard for work in the Far East. For the benefit of the chemists and geologists a combination gas and gasoline muffle furnace has been constructed. With the gas, coal, and gasoline furnaces on hand almost any kind of assay work can be handled expeditiously.

The core samples from about 75 artesian wells were examined during the year. A large number are on hand to be examined, but the pressure of work along other lines has caused considerable delay in handling these samples, and we are badly behind. The work of examining mineral specimens and rocks continues daily, and an increased interest in the rarer minerals is being manifested by those who have had some experience in mineralogy. About 300 mineral specimens have been examined free of charge. When I returned to duty from the United States, I brought with me samples of the commonest radium ores of Colorado. They are on display at the Bureau of Science and have been especially called to the attention of prospectors in the Philippines in order that they might be on the lookout for the occurrence of similar ores.

The usual drafting necessary in the preparation of maps and drawings for publication in the Philippine Journal of Science has been carried on and in addition a great many placards were made for the exhibit of this institution at the Northern Luzon Fair. The draftsmen showed their interest in the affairs of the Bureau of Science by doing a great deal of overtime work in preparing models for this exhibit.

Field work.—The Bureau of Science has not been able to keep up with the demand for mine examinations and other geologic work. During the year the geologists have made professional examinations of the limestone deposit near Laguna de Bay, the Surigao iron-ore deposit and the neighboring gold deposit, the Leyte oil and asphalt deposit, the Lubang oil deposit, the Cabu River placer deposit, the Acupan mining property, and the Benguet Consolidated Company mining property. Several of these examinations were paid for by private parties. A geologist made several trips to Mindoro and while there made geologic examinations for private parties, studied the geology of the island, and investigated the occurrence of quartz sand. We have had a number of demands for good quartz sand for molding purposes, for cleaning castings, for cement work, for pottery use, and as a smelter flux. There is an abundant supply of quartz sand near Puerto Galera, Mindoro, suitable for such purposes. The last week of the year was utilized in consultation work at Baguio in connection with the Northern Luzon Fair.

Mining legislation.—The past year has been marked by much interest in legislation concerning mining. The tax placed on the gross output of mines has not affected the mining industry as much as was anticipated by those interested in mines. No company was forced to stop operation because of its application. The Bureau of Science has furnished information during the year on the wharfage tax. There can be no doubt that this tax holds back mineral exportation, and it remains for the Legislature to decide whether the mineral resources of the Islands should be developed or should be conserved. The division of mines of the Bureau of Science is in a better position to know the needs of the mining people, the mineral possibility of the Philippine Islands, and the defects and needed changes in the mining laws than any other department of the Government, and any proposed changes or new laws should be referred to the Bureau of Science for study. Some of the old Spanish laws in regard to locating and working claims could be adopted to advantage. Under the present system a great deal of ground is being held for speculation, and development is retarded.

Publications.—The papers that the scientists of this division have contributed to the Philippine Journal of Science are included in the list given on page 45. Numbers 3, 4, and 5 of the Philippine Journal of Science, Section A (1915), Volume X, were devoted entirely to geologic papers. The Mineral Resources of the Philippine Islands for 1914 has been printed and distributed. It contains the following articles:

Staff, division of mines, Bureau of Science.
Review of Philippine mining in 1914, by Wallace E. Pratt.
Statistics of mineral production in the Philippines in 1914, by Victor E. Lednicky.
Gold production of the Philippine Islands in 1914, by Wallace E. Pratt.
Gold mining in the various districts in 1914, by Wallace E. Pratt.
Production of iron and nonmetals in 1914, by Wallace E. Pratt.
Copper deposits in Zambales Province, by Victor E. Lednicky.
Notes on the mineral resources of Surigao Province, by Wallace E. Pratt.
The Lubang gold district in southern Benguet, by Victor E. Lednicky.

In spite of the general unsatisfactory economic conditions throughout the world Philippine mining has made much progress, and during the latter part of the year a decided boom has been apparent. There remains a great deal of work to be done along geologic and mining lines in the Philippine Islands, and it is to be regretted that the personnel of the division of mines of the Bureau of Science is so restricted.

PHILIPPINE MUSEUM

The best of the museum exhibit was sent to San Francisco as a part of the Bureau of Science exhibit at the Panama-Pacific International Exposition. The Bureau of Science display consisted of about 4,000 items representing the following:

1. Applied chemistry in Philippine industry, including numerous samples of wood distillates and charcoals; tan barks; tanning cutch and tanned hides; paper made from local fibers; fruit products; essences; oils and beverages; information with regard to Philippine water supply from sanitary and commercial standpoints; Philippine coals, their analyses and results of physical and chemical tests; cement and concrete; limestone and lime from local resources; sand-lime bricks; tile; clay products and polished artificial marbles made from Philippine raw materials; various products from leaves, for example, roselle; and nipa palm and its products.
2. Philippine mineral resources and geology, including ores, coal, corals, fossils, and shells; models of Philippine processes and of gold production by years; relief maps; geologic and mineralogic maps; charts showing economic mineral products by years and distribution; and photographs.
3. Philippine ethnology, portraying the life, industries, and occupations of people in the Philippines, including everything from small ornaments, cloths, and garments to weaving looms, household utensils, tools, agricultural implements, fishing boats, and even models of their houses; and miscellaneous industries, such as fish, hemp, rope, basket, and hat making.
4. Philippine economic fishery products and resources, including food and game fishes, window and button shells, tortoise shell, and sponges.
5. Mounted Philippine botanical specimens.
6. An exhibit of the Philippine Journal of Science and colored transparencies illustrating the Philippine Islands.

The exhibit was exceedingly well received in San Francisco. It was packed and completely prepared for return to the Philippine Islands on January 1, 1916, and will be returned on the United States Army Transport leaving San Francisco in February, 1916. The Government deemed it unwise to leave the museum building only partly occupied when the space was needed. Accordingly the specimens left in Manila were stored, and the building on Calle Juan Luna was vacated for the use of the Bureau of Forestry as an office building. The Sales Agency Building on the Luneta extension near the Manila Hotel has been assigned to the Bureau of Science, and the material returned from San Francisco and other material now on hand in the Bureau of Science will be segregated here for a commercial, industrial, and general museum of the Philippine Islands. We shall begin its arrangement about April 1 after the San Francisco exhibit arrives.

LIBRARY

Personnel.—Miss Mary Polk remains as chief librarian. The loss of Miss Lucia May Brooks, who left Manila in June to return to her regular duties in the library of Leland Stanford Junior University after a year in the Orient, was keenly felt. No trained technical assistant has been secured in her place. Mrs. Mary L. Crozier, employed on April 19, 1915, has been very helpful in certain branches of the work, but is not trained for technical work. No other changes were made during the year except in the temporary apprentices.

Routine.—The following table gives the record of technical work performed:

	Titles.	Volumes.	Parts.	Cards.
Classification and cataloguing	771	2, 926	1, 821	4, 923
Reclassification and cataloguing	79	466		717
Total	850	3, 392	1, 821	5, 640
Printed cards				10, 419
Total cards filed in official catalogue				16, 059

The accessions during the calendar year were 1,172 volumes, making a total of 32,032 bound volumes in the library on December 31, 1915. Work with printed cards has been carried forward as rapidly as possible. In no other part of the library are we getting as much for the money expended as through the addition of Library of Congress cards, which we are making regularly to our official catalogue. Valuable exchange material and gifts are received regularly in large quantity. Four thousand volumes were prepared and sent for binding during the year. An inventory undertaken during the year is nearly completed. During the year six double sections were added to the stacks, giving approximately 1,500 feet of much needed additional shelving.

Cuts.—There were 4,910 cuts in place at the end of the year; approximately 150 remain unentered.

Bound sets of the Philippine Journal of Science.—The demand for bound sets of the Philippine Journal of Science now on the shelves of the library has been so great that it was decided to bind six additional sets from the reserve stock formerly set aside to meet this demand and to provide for permanent preservation of these sets.

Union catalogue.—The Library of Congress proof sheets, which we cut and file as a reference catalogue, were filed to date until about the middle of the year. Since that time the galleys have accumulated, and we now await opportunity again to bring this work up to date. This reference catalogue, now occupying 288 standard cabinet trays, is easily the best single reference tool in the Philippine Islands.

Use.—The library serves not only the workers in the Bureau of Science, but all scientific workers in the Philippine Islands, including representatives of the United States Army, the United States Navy, the United States Marine Corps, the United States Public Health Service, and other Federal departments, the other bureaus of the Insular Government, the professors and students in all the colleges of the University of the Philippines, students of the schools of Manila, outside visitors, etc. The average daily circulation was over 49, and the average number of publications returned daily was over 40, leaving 3,341 more publications charged at the end than at the beginning of the year. Closer check over the circulation is necessary for efficiency, but the pressure of other work has prohibited any change in method during the year.

Library training.—The librarian and assistant librarian of the Bureau of Science conducted the work of the Library training class of the College of Liberal Arts of the University of the Philippines from February 1 to the end of the college year. The third-year class of the College of Medicine and Surgery received lectures on elementary methods in library usage during the second half of the college year 1914-15, while the fifth-year class received seven lectures, with practice in the library during the first half of the college year 1915-16. Each student in these courses was taught the use of the more important reference tools in scientific subjects and was required carefully to prepare a bibliography on one medical subject.

THE PHILIPPINE JOURNAL OF SCIENCE AND OTHER PUBLICATIONS

During 1915 the Philippine Journal of Science was issued as usual in four sections, each of which contained six numbers, somewhat smaller than heretofore. Each section is separately paged and indexed. The following table shows the number of pages, plates, and text figures contained in each section of Volume X:

	Section A.	Section B.	Section C.	Section D.
Pages	408	394	434	416
Plates	30	15	19	24
Text figures	40	89		63

The numbers of the Philippine Journal of Science for Volume X, 1915, contain the following articles. Names of members of the Bureau of Science staff are marked by asterisks.

SECTION A. CHEMICAL AND GEOLOGICAL SCIENCES AND THE INDUSTRIES

No. 1, January, 1915

*Pratt, David S. Papain: Its commercial preparation and digestive properties.

Blackwood, O. H. A determination of the diurnal variation of the radioactivity of the atmosphere at Manila by the active deposit method.

*Gibbs, H. D., and *Brill, H. C. Diethylsuccinosuccinate (ethyldioxydihydroteraphthalate): A study of its constitution, some derivatives, and absorption spectra.

*Heise, George W. Water supply for the city of Iloilo.

———. Boiler water of Iloilo Province.

*Smith, Warren D., *Eddingfield, F. T., and *Fanning, Paul R. A preliminary check list of Philippine minerals.

Reviews.

No. 2, March, 1915

*Gibbs, H. D. Proposed modification of ylang-ylang oil standards.

*Brill, Harvey C., and *Agcaoili, Francisco. Philippine oil-bearing seeds and their properties: II.

———. The enzymes of cacao.

*Heise, George W. Water supplies in the Philippine Islands: II.

Reviews.

No. 3, May, 1915

*Smith, Warren D. Notes on a geologic reconnaissance of Mountain Province, Luzon, P. I.

———. Notes on the geology of Panay.

No. 4, July, 1915

*Pratt, Wallace E. The location of artesian wells in the Philippine Islands from a geologic viewpoint.

———. Petroleum and residual bitumens in Leyte.

———. On the occurrence of petroleum in the Province of Cebu.

No. 5, September, 1915

*Pratt, Wallace E. The persistence of Philippine coal beds.

———. Geologic reconnaissance in Caramoan Peninsula, Camarines Province.

———. Iron ore on Calambayanga Island, Mambulao, Camarines.

———, and *Lednicky, Victor E. Iron ore in Surigao Province.

No. 6, November, 1915

*Gana, Vicente Q. The leather industry of the Philippine Islands.

*Cox, Alvin J., and *Dar Juan, T. Salt Industry and resources of the Philippine Islands.

SECTION B. TROPICAL MEDICINE

No. 1, January, 1915

Munson, E. L. Cholera carriers in relation to cholera control.

*Schöbl, Otto. Observations concerning cholera carriers.

Wharton, Lawrence D. The development of the eggs of Ascaris lumbricoides.

*Ruediger, E. H. The occurrence of Bacillus coli communis in the peripheral blood of man during life.

———. The preparation of tetanus antitoxin.

Calderon, Fernando. Cæsarean section in the Philippine Islands.

Woodward, R. B. Case report of obstructed labor and cæsarean section.

Thornburgh, Robert M. Adenocarcinoma of the cæcum, complicated by intussusception.

DuMez, A. G. Two compounds of emetine which may be of service in the treatment of entamœbiasis.

Albert, José. The treatment of infantile beriberi with the extract of tiqui-tiqui.

Philippine Islands Medical Association. Minutes of the eleventh annual meeting, held at Manila, November 4–7, 1914.

Editorial. Progress in the investigation of vitamines.

Review.

No. 2, March, 1915

*Williams, R. R., and Saleeby, N. M. Experimental treatment of human beriberi with constituents of rice polishings.

———, and *Crowell, B. C. The thymus gland in beriberi.

*Schöbl, Otto. Practical experience with some enriching media recommended for bacteriological diagnosis of Asiatic cholera.

*Barber, Marshall A. I. Experiments on the immunization of guinea pigs by the inoculation of avirulent tubercle bacilli in agar. II. Observations on animals inoculated with tuberculosis from lepers.

———, and Jones, Charles R. A test of Coccobacillus acridiorum d'Herelle on locusts in the Philippines.

No. 3, May, 1915

*Barber, M. A.; *Raquel, Alfonso; *Guzman, Ariston; and *Rosa, Antonio P. Malaria in the Philippine Islands. II. The distribution of the commoner anophelines and the distribution of malaria.

No. 4, July, 1915

*Crowell, B. C. Pathologic anatomy of bubonic plague.

No. 5, September, 1915

Roberg, David N. The rôle played by the insects of the dipterous family Phoridæ in the spread of bacterial infections. Experiments on Aphiochæta ferruginea Brunetti with the cholera vibrio.

*Williams, Robert R., and *Johnston, John A. Miscellaneous notes and comments on beriberi.

Schüffner, Wilhelm. Pseudotyphoid fever in Deli, Sumatra (a variety of Japanese kedani fever).

Reviews.

No. 6, November, 1915

Denney, Oswald E. The treatment of the retrogressive skin lesions of leprosy with basic fuchsin.

*Johnston, John A. Leprosy.

Calderon, Fernando. Tropical obstetrical problems.

Coulter, J. S. A study of the pathology of the gall bladder and biliary passages in cholera.

SECTION C. BOTANY

No. 1, January, 1915

*Merrill, E. D. New or noteworthy Philippine plants, XI.

No. 2, March, 1915

Patouillard, N. Champignons des Philippines communiqués par C. F. Baker, II.
*Merrill, E. D. Studies on Philippine Rubiaceae, II.
Copeland, E. B. Notes on Bornean ferns.
Review.

No. 3, May, 1915

*Merrill, E. D. The present status of botanical exploration in the Philippines.
———. Genera and species erroneously credited to the Philippine flora.
———. New species of Schefflera.
———. New species of Eugenia.

No. 4, July, 1915

*Merrill, E. D. Studies on Philippine Anonaceae, I.
———. Plantae Wenzelianae, III.

No. 5, September, 1915

*Merrill, E. D. New or noteworthy Philippine plants, XII.

No. 6, November, 1915

Rundles, John C. Studies in rice.
Teodoro, Nicanor Gregorio. A preliminary study of Philippine bananas.

SECTION D. GENERAL BIOLOGY, ETHNOLOGY, AND ANTHROPOLOGY

No. 1, January, 1915

Light, S. F. Notes on Philippine Alcyonaria. Part III: Two new species of Lithophytum Forskål from the Philippines.
Cowles, R. P. The habits of some tropical crustaceans.
Heller, K. M. Neue Käfer von den Philippinen: II.
Baker, C. F. Studies in Philippine Jassoidea: II, Philippine Jassaria.
Griffini, Achille. Prospetto dei Grillacridi delle Isole Philippine.
Poppius, B. Neue orientalische Bryocorinen.

No. 2, March, 1915

Taylor, Edward H. New species of Philippine lizards.
Wharton, Lawrence D. The eggs of Ascaris lumbricoides.
Bernhauer, Max. Zur Staphylinidenfauna der Philippinen: VI. Beitrag zur Kenntnis der indo-malayischen Fauna.
Grouvelle, A. Dryopidæ et Heteroceridæ des Philippines.
Baker, C. F. Notices of certain Philippine Fulgoroidea, one being of economic importance.
Cowles, R. P. Are Atya spinipes Newport and Atya armata Milne Edwards synonyms for Atya molluccensis De Haan?
Light, S. F. Notes on Philippine Alcyonaria. Part IV: Notes on Philippine Stolonifera and Xeniidæ.

No. 3, May, 1915

Kemp, Stanley. On a collection of stomatopod Crustacea from the Philippine Islands.

Baker, C. F. Studies in Philippine Jassoidea: III, The Stenocotidæ of the Philippines.

Light, S. F. Notes on Philippine Alcyonaria. Part V: Cornularia minuta, a new species.

*Seale, Alvin. Note regarding the dugong in the Philippine Islands.

No. 4, July, 1915

Heller, K. M. Neue Käfer von den Philippinen: III.

Baker, C. F. Two Amphipoda of Luzon.

Crawford, D. L. Ceylonese and Philippine Psyllidæ (Homoptera).

*Schultze, W. Erster Beitrag zur Coleopteren Fauna der Philippinen.

No. 5, September, 1915

Wileman, A. E. Notes on Japanese Lepidoptera and their larvæ: Part II.

Day, Artemas L. Difficulties encountered in the culture of baños, or milkfish, in Zambales Province.

No. 6, November, 1915

Baker, C. F. Studies in Philippine Jassoidea, IV: The Idiocerini of the Philippines.

Wileman, A. E. Notes on Japanese Lepidoptera and their larvæ: Part III.

Funkhouser, W. D. Review of the Philippine Membracidæ.

The Mineral Resources of the Philippine Islands for 1914 was issued during the year, as was also a small pamphlet entitled Birds in their Economic Relation to Man. The new publication folder which was sent to press in 1914 was issued early in 1915. Translations into Spanish entitled "La industria de curtidos en las Islas Filipinas" and "La fabricación del azúcar" were issued. These pamphlets are for free distribution.

A catalogue of Philippine Coleoptera, consisting of about 200 pages, was received in first revised page proof at the end of the year.

The serial numbers and the titles of press bulletins issued during the year are as follows:

No. 35. Notas de interes para los hacenderos de azucar. [January 28, 1915.]

Leaflet. Notas de interes para los hacenderos de azucar. [February 18–23, 1915. Silay Exposition and Carnival.]

No. 36. Investigation of iron-ore deposits in Surigao, Mindanao. [February 6, 1915.]

No. 37. Philippine gold production for 1914 shows great increase. [February 6, 1915.]

No. 38. Mosquitoes and malaria in the Philippine Islands. [February 8, 1915.]

No. 39. The return to Manila of the Bureau of Science party which made a survey of the iron ore in Surigao Province. [March 31, 1915.]

No. 40. New gold mining near Iligan, Mindanao. [April 14, 1915.]
No. 41. La mejora de la industria del curtido de las Islas Filipinas. [May 20, 1915. Spanish.]
No. 42. Asphalt in Leyte. [June 10, 1915.]
No. 43. Copper deposits in Zambales Province. [June 15, 1915.]
No. 44. Rock asphalt in Leyte. [July 2, 1915.]
No. 45. Iron-ore deposits in Surigao. [July 13, 1915.]
No. 46. Copra: Fifteen million pesos loss of the Philippine industry in five years. [October 14, 1915. English and Spanish.]
No. 47. Rabies in the Philippine Islands. [October 22, 1915. English and Spanish.]

A ten-year index of the Journal was begun in October. During two months about 30,000 cards were typed, but toward the end of the year practically nothing was done on the index owing to more urgent work in other lines.

The blanks and labels required by the various divisions have been printed.

The mailing list of the Philippine Journal of Science for the past two years has been as follows:

	1914	1915
Paid subscriptions	347	320
Exchanges	465	470
Reviews	64	66
Free	49	49
Total mailing list	925	905

Owing to the general unstable business conditions throughout the world as a whole, it is gratifying that the Philippine Journal of Science has been so fortunate as to retain its paid subscription list practically unchanged.

POWER PLANT

Personnel.—There has been no change in the engineering personnel. It has remained as heretofore, entirely Filipinized, with Mr. José Guerrero y Reyes as chief power engineer and Mr. Felix Valencia as assistant engineer.

Power.—During the year the supply of gas for the Philippine General Hospital and the Colleges of Medicine and Surgery and of Liberal Arts was closed. The Manila Gas Corporation is now operating a city supply and is furnishing these institutions. The Philippine General Hospital steam supply was closed on December 15, it having been decided that it was cheaper to use gas than steam for cooking purposes, especially when steam had to be delivered so far. The other functions of the central power plant for the Philippine General Hospital, the Bureau of Science, and the College of Medicine and Surgery remain unchanged.

Producer-gas plant.—The producer-gas generator and the gas engine have proved their reliability and economy under intelligent supervision and care.

Boiler plant.—The two Dutch ovens installed last year in front of the two old boiler units are satisfactory. The arrangement produces complete combustion. The improved furnaces produce such intense heat with the present baffling system that no fire brick can stand it for a long time. The baffles have to be repaired every few months to maintain smokeless operation. With intelligent firing the smoke now emitted from the chimney is negligible. The plan that we have used can be advantageously followed elsewhere for the prevention of smoke. The boilers can stand a higher overload now than before the modifications were made.

Costs.—The average cost per kilowatt hour of electric current was slightly over 10 centavos. This was somewhat higher than during the former year due to the increased cost of coal. The cost of the production of electric current could be considerably reduced by the addition of another producer-gas generator.

Mansfield gas-generating plant.—The total gas generated was more than 700,000 cubic feet (19,824 cubic meters). The cost of production has been considerably lowered by the use of naval fuel oil in the retorts and dilution with producer gas.

Shop.—The number of shop requests is shown by the following table.

	Requests.
Bureau of Science	305
Bureau of Public Works	1
Bureau of Health	1
Private	5
Total	322

CLERICAL DIVISION

The clerical work of the Bureau of Science has progressed and has been a satisfactory tool in the scientific work of the institution. Chief Clerk A. E. Southard returned from his detail as private secretary to the Honorable, the Secretary of the Interior, on February 15 and on March 26 went on leave to China and returned to duty in the Bureau of Science on September 1. During his absence the duties of chief clerk were performed by Mr. C. J. Stancliff, property officer, cashier, and disbursing officer. Mr. Harold Evans was transferred in August from the Bureau of Science to the Department of Police of the city of Manila for the reason that he was offered a higher salary there than was available in the Bureau of Science. Mr. L. G. Thomas was appointed as a temporary employee on December 1 to the place left vacant by the transfer of Mr. Evans.

During the middle of the year representatives of the Insular Auditor were engaged in making a complete inventory of the property, equipment, and supplies of the Bureau, and since the return of the chief clerk, Mr. Stancliff and the other members of the property office have been working long and hard in checking the inventory.

The improvement of the Bureau of Science grounds is being carried on, as it can be done economically. Many low levels have been raised by excavating the good earth and filling below with ashes from the power plant. The grounds have also been beautified by rearranging the ornamental shrubbery and the mulberry bushes that furnish food for the silkworms. In some places a single, red hibiscus has been substituted for the "violeta" as a hedge plant. The janitor and his assistant have taken particular interest in thus grading and beautifying the grounds. The breeding of guinea pigs has continued successfully. We not only have sufficient for supplying the needs of our medical laboratory, but have a surplus for other institutions. We have had also some success with breeding rabbits.

PHOTOGRAPHY

The record of the photographic work is as follows:

Nature of work.	Calendar year 1914.	Calendar year 1915.
Negatives taken or developed	458	374
Lantern slides	875	434
Prints, 5 by 7 inches	10,718	3,185
Prints of various sizes	------	963
Enlargements	262	50
Transparencies, 8 by 10 inches	53	3

AQUARIUM

The aquarium of the Bureau of Science has continued to be much appreciated. It is clearly one of the most attractive diversions in Manila, and I have received many letters commending it. The aquarium is self-supporting. There were enough paid admissions during the year to reimburse the Government for its upkeep. I have continued to admit students and teachers of schools by special arrangement. This has been very much appreciated, and during the year there were 16,369 free admissions. In the aquarium at present there are over 700 specimens, representing 202 species of fishes and various species of crabs, lobsters, prawns, turtles, crocodiles, etc. The clerical work in connection with the aquarium at first caused considerable overtime work, but now it has been systematized to such an extent that all work in connection therewith is performed efficiently with very little effort.

BUREAU OF SCIENCE EXHIBIT AT THE NORTHERN LUZON FAIR

The Bureau of Science sent to San Francisco for the Panama-Pacific International Exposition 72 large packing cases filled with exhibits, so that material for the Northern Luzon Fair had to be drawn from residual material and that accumulated during the year. However, a very creditable mining, chemical, and photographic display was arranged. Baguio, Benguet, where the fair was held, is the center of a mining district, and for that reason the mining exhibit of the Bureau of Science attracted unusual attention. A geologist accompanied the exhibit and was able to give valuable information to visitors at the fair interested in chemical and mining problems. Several hundred copies of our catalogue of publications and of the pamphlet entitled Industrial Resources of the Philippine Islands were distributed.

RECOMMENDATIONS

During the past calendar year we have had available for the work of the Bureau of Science ₱379,890. I have annually pointed out that the work of maintaining a constantly growing bureau, which in effect is a department of information and must keep abreast with development in many lines, is much handicapped by an insufficient appropriation. During each of the last three years there has been an increase in the amount of fixed work and a decrease in the appropriation. It follows that many important constructive problems remain untouched. Progressive work should be carried on all the time to prevent expensive duplication and waste and to attract and hold good men. From the foregoing pages it is clear that there is the greatest need of more scientific employees.

The Bureau of Science is charged by law with the performance of the laboratory work necessary for the enforcement of the sanitary measures in the Philippine Islands. We should have personnel sufficient to combat any epidemic that may arise; when epidemics are under control, we should carry on investigations such as those that have led to the control of entamœbic dysentery and the isolation of the cholera carrier.

Each year shows more clearly that thousands of pesos could be saved annually to the sugar growers alone, if they had the scientific information necessary with regard to planting, harvesting, and recovering sugar most efficiently and economically. More perfect extraction and more careful handling of the juice should increase the production and improve the quality of the sugar, even if there is no increase in the yield or in the planted area. The best way to improve and increase the sugar production of the Philippine Islands is by the careful application of scientific knowledge.

Many hacenderos in Negros believe that there is a secret process in the manufacture of sugar. A prominent planter told me that it was impossible to get more than 77-degree sugar from one cane, which gives a dilute juice, whereas he got 88-degree sugar from another variety. In the same way I was told that it was impossible to manufacture sugar from nipa juice, because it would ferment. We easily overcame the effects of the oxidase secreted by the nipa palm in the latter case, and similarly we can overcome the former difficulty, if we have trained men to send into the field to study conditions as they actually exist. I should like to send a staff to Negros with a field laboratory to make analyses and to give lectures and demonstrations throughout the province and thus efficiently make the hacenderos familiar with the principles of sugar making and of training sugar-mill laborers in the necessary manipulation in the factory. There should be employees enough to give instruction and information on subjects such as the following:

1. The necessity for determining the purity of the cane before cutting.
2. The advantages to be gained on large haciendas by planting the Cebu, the Inalmon, and the Lahaina varieties in addition to the Moradi cane. With such a diversity the milling period would be greatly lengthened, and the cutting of overripe or underripe cane could be avoided.
3. The construction and the arrangement of the mill and of the means for conveying the cane to the mill.
4. The care and the storage of cut cane.
5. Cleanliness and proper sterilization in and around the mill.
6. The efficiency of formaldehyde as an antiseptic for cleaning cauas, tanks, etc.
7. Proper extraction and proper handling of the juice before and during evaporation.
8. Purity and quantity of lime to be used, with a demonstration of the

quality produced in the Bureau of Science experimental kiln and instruction as to how proper kilns can be made and operated.

9. Harmful effects of a deficiency or excess of lime in the juices.
10. Demonstration to show that a dilute juice will produce a better sugar if mixed in proper quantities with a more concentrated juice and that a rapid rate of evaporation and rapid concentration of a dilute juice prevents the inversion of sugar and results in a better product.

No entomologist has been on duty in this institution for several months, but the need is exceedingly apparent. On October 18, 1915, I received a request from the Assistant Director of Health asking for the identification of Surigao specimens of bed bugs from a bed, lice from the hair of a woman's head, ticks from a hog, and flies from market refuse. I have just received a letter which reports a plague of centipedes on an island situated off the coast of Pangasinan between the municipality of Anda and that of Alaminos, which is "causing much pain and inconvenience" to the inhabitants. The report requests recommendation as to the best method of exterminating or reducing the number of centipedes. Whenever possible, work of this kind is performed by the Bureau of Science, but it is frequently accomplished by the generous assistance of a former employee now not connected with the Government. These are only two of many requests and indicate a large amount of experimental study and work in preparing information necessary to assist the Bureaus of Health, Forestry, Agriculture, etc.; in the study of poisonous insects and those responsible for the spread of disease; those injurious to timber trees, agricultural plants, etc.; and injurious insects that are held in check by birds, etc. Also entomologists will be of great assistance to the work of the sanitary commissions that are now in operation. The employment of at least two during 1916 is recommended.

The desirability of extending the silkworm industry within the Archipelago becomes more apparent each year. However, there seems to be a hiatus between the Bureau of Science and the people who could profit by the silk industry. The Bureau of Science has the information with regard to silk culture, silkworm eggs, and the mulberry trees, but no adequate method of inducing the people in the provinces to take up the industry. Demonstrators, preferably Filipinos, who should have Government support in establishing small silk farms in favorable localities so that the people could actually see the results that can be secured, should be used to induce the people of these Islands to engage in the industry.

The information we have with regard to the industrial, economic, and sanitary development of the Philippine Islands is not sufficiently used. I desire to emphasize the fact that there is extensive information along many lines in the Bureau of Science that should effect a large annual saving to the inhabitants of these Islands, if it were utilized. There is no adequate means of putting the people of the Islands in touch with this information. The best and probably the only way to interest those to whom the introduction of desirable modifications of existing methods is most important is by actual demonstration.

The suggestion has been made that the Philippine Journal of Science is not sufficiently popular in form. Popular information is only of passing interest, but the Philippine Journal of Science prints concise, accurately edited facts. By far the best plan is to publish concise, accurate, scientific literature and to bring this information to the inhabitants of these Islands by personal demonstration. We should have available in the Bureau of Science men whose work it should be to demonstrate the modifications in the drying of copra, the extraction and handling of the sugar-cane juices, the tanning of leather, the manufacture of lime, the extension of the silkworm industry, etc. Recently in my office a Spanish coconut grower discussed the drying of copra. He had lived in Laguna ever since American occupation of the Philippine Islands and had never before visited the Bureau of Science. His visit on this occasion was the direct outcome of a conversation with a representative of the Bureau of Science when the latter was in Laguna in the furtherance of our copra-drying propaganda. I recommend that provision be made for a corps of demonstrators in the Bureau of Science.

It is recommended that the Government provide for sending the most capable and advanced library assistants of the Bureau of Science to the United States for further professional training in order that the Philippine Islands may have available a group of trained employees for carrying on library work of a high order and for teaching in the library-training courses.

The matter of safe-guarding the herbarium has been brought up year after year. Somewhat over a year ago all types of Philippine plants were segregated and stored in separate cases, distinct from the general herbarium, in the concrete east wing of the Bureau of Science building. During my absence in the United States the entire herbarium, except the fungi, was transferred to the quarters in the new wing formerly occupied by the entomological collection. While the new quarters are very cramped, very inconvenient, and necessitate the arrangement of the cases in tiers of three rather than in tiers of two, the inconveniences are to a degree offset by the knowledge that the large and valuable collection is now reasonably safe from destruction by accidental fire. It is to be hoped, however, that more adequate and better-arranged quarters can be provided in the near future, for now all work of consulting the herbarium is done with a very great loss of time and energy. Moreover the work is badly scattered. The herbarium occupies three rooms in the east wing, the mycologist is in a distant room in the main building, the physiologist is in still another isolated and distant room on the ground floor of the main building, while the botanical workroom is also distant from the herbarium near the physiologist's office.

Ever since the Bureau was organized, considerable attention has been given to the study of medicinal plants. Many data have been accumulated, and we now definitely know a large percentage of the plants actually used by the Filipinos in the practice of medicine. The commercial medicinal plants of the Philippines are few, but those utilized by the Filipinos total several hundred species. Very many of these have never been critically studied by chemists, pharmacists, and physicians, and it is probable that some of our numerous plants, on investigation, will prove to have distinct curative values. It is hoped that during the coming year we may be able to undertake a comprehensive survey of the medicinal plants of the Archipelago. The matter of classification will be simple, but the whole question is exceedingly complex and will involve coöperation of botanists, pharmacists, chemists, and physicians. It is believed that such coöperative work can be arranged, but primarily the inception of the work involves the addition of another member to the botanical staff whose major work shall be the general direction of the medicinal-plant survey.

Year by year I have pointed out the desirability of commencing a comprehensive, systematic enumeration of Philippine plants. The Philippines has a Flora de Filipinas, published in 1837, but the work is absolutely inadequate; even when published, it was obsolete in arrangement. Systematic botany is carried on by every government as a matter of pride and as a necessary part of its scientific work. What some other countries have done in the way of floras may be judged by the following:

India had a published flora as early as 1832, and it is but fifteen years since Hooker's Flora of British India was published. Flora Australiensis was published in 1860–75; Flora Hongkongensis, 1865; Flora of the British West Indies, 1862; Flora of Ceylon, 1890–1900; Flora of the Malay Peninsula, 1885–date; Flora von Nederlandisch Indie, 1855-60; Flora Capensis (South Africa), 1865–date; Flora of Tropical Africa, 1870–date; Flora de Indo-Chine, 1905–date. The Germans, the French, and the English are industriously turning out floras of their respective colonies, and even the Japanese are doing relatively more work on the flora of Formosa than the Philippine Government is doing on the flora of the Philippines.

Mr. Merrill has worked for twelve years on the flora of the Philippines, and his accumulated knowledge is worth much to this Government. It is improbable that any one else will ever be so well fitted for the preparation of a flora of the Philippines. I recommend that the personnel of the Bureau of Science be increased and so adjusted that he can devote a considerable uninterrupted time to the preparation of such a manuscript, in order that his knowledge of Philippine plants and of the literature relating to them will be in permanent form.

Year by year I have pointed out the need of funds for a new wing to supply adequate quarters and against possible destruction by fire of our scientific collections, funds for a soil survey, for the investigation of the subject of animal diseases, of insects injurious to agricultural products, a water survey, the purchase of books necessary to complete sets now in the central scientific library, reissuing of exhausted editions of certain publications, and enlarging the scope of our present work on the fish and fisheries of the Philippine Islands. These things are more and more urgently needed as time goes by.

Tables, showing the routine work performed and supplies manufactured and disposed of during the calendar year 1915 by the Bureau of Science, and the financial statement, showing the appropriation and how it was expended, are attached hereto.

Respectfully submitted.

ALVIN J. COX,
Director, Bureau of Science.

To the Honorable,
The SECRETARY OF THE INTERIOR.

TABLE I.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1915, as compared with the fiscal year 1914, by number or quantity and by value, arranged by subdivisions of the Bureau of Science.*

Subdivision of the Bureau of Science.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
General, inorganic, and physical chemistry.						
Metals and alloys	51	44	32	18	436.50	243.00
Rocks, minerals, natural pigments, and similar substances	----------	15	----------	----------	----------	----------
Clays, shales, limestones, limes, wall plasters, cements, and slags	11	5	5	2	27.00	28.00
Fertilizers	14	34	12	22	132.00	246.20
Soils and similar substances	42	365	30	----------	693.00	----------
Coal analyses	22	50	19	49	276.00	385.40
Calorimetric test of fuels	7	34	6	34	120.00	672.00
Waters	208	201	15	32	365.00	611.50
Crude chemical and miscellaneous analyses	88	135	58	115	289.50	497.00
Standard solutions	30	20	5	2	29.00	9.00
Physical tests of wire, twine, fiber, textile, paper, and similar articles	31	32	31	32	90.50	87.00
Cements	6,817	6,716	6,817	6,696	7,641.20	9,427.15
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	86	203	86	203	330.00	635.40
Standardization of road materials	15	71	15	71	170.15	467.40
Standardization of units of measures:						
Lengths	171	60	170	60	88.50	6.00
Capacities	312	121	312	121	99.40	27.10
Weights	776	31	776	31	79.95	16.95
Miscellaneous	41	22	41	22	54.00	15.50
Total	8,722	8,159	8,430	7,510	10,921.70	13,374.60
Organic chemistry.						
Urines, clinical and toxicological analyses	232	192	77	80	469.00	274.00
Essential oils and essences	14	11	13	11	89.50	77.50
Petroleum and products, copra, and similar materials	68	20	11	10	89.50	98.00
Paints, varnishes, and linseed oils	42	63	33	54	319.00	412.65
Gums, resins, and similar materials	----------	1	----------	1	----------	5.00

TABLE I.—*Comparative table of routine work performed, etc.*—Continued.

Subdivision of the Bureau of Science.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Organic chemistry—Continued.						
Paper and similar materials	104	117				
Gastric juice, clinical examinations	52	2	3	2	15.00	95.00
Foods, alcohols, and beverages	640	2,921	256	245	884.00	951.20
Food preservatives and coloring matters	5	25	2	15	4.00	89.00
Medicines and similar articles	48	120	16	24	140.00	485.00
Miscellaneous chemical analyses and examinations	89	178	24	36	100.00	298.04
Total	1,294	3,650	435	478	2,110.00	2,785.39
Mines.						
Assays	411	677	403	650	653.45	957.76
Biological laboratory.						
Fæces	[a] 126,226	50,021	426	1,118	1,371.00	3,352.33
Sputum	2,095	85	36	21	108.00	63.00
Blood	6,398	29	140	22	422.00	210.00
Blood culture	392	2	4	2	20.00	10.00
Widal test	599	5,166	9	6	33.00	18.00
Wassermann test	1,259	633	304	257	3,040.00	2,502.88
Leprosy	1,132	569	3		9.00	
Urines	4,275	2	81	1	242.00	25.00
Gonococci	16,379	15,832	24	10	72.00	30.00
Waters	2,243	2,986	8	11	320.00	350.00
Necropsies	401	117				
Histological examinations	256	473	8	13	80.00	130.00
Rabies	36	21				
Plague	65	1				
Rats for plague	[a] 113,337	79,298				
Miscellaneous biological examinations	1,755	10.035	58	9	548.00	48.00
Total	276,848	165,270	1,101	1,470	6,265.00	6,739.21
Serum section of the biological laboratory.						
Vaccine virus ..... doses	2,636,335	1,788,666	2,636,335	1,788,666	29,383.05	18,976.60
Antirinderpest serum cc	134,333.33		134,333.33		230.29	
Mallein ..... doses	815	10	815	10	545.50	10.00
Miscellaneous sera and preparations cc	6,524,090	5,208,941	6,524,090	5,208,940	15,009.82	12,785.00
Total	9,295,573.33	6,997,617	9,295,573.33	6,997,616	45,168.66	31,771.60

[a] The two items "fæces" and "rats for plague" were excessive during 1914 on account of the presence of cholera and plague, and 110,244 more of these examinations were made in 1914 than in 1915.

TABLE I.—*Comparative table of routine work performed, etc.*—Continued.

Subdivision of the Bureau of Science.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Miscellaneous.						
Photographs	16,161	4,971	14,339	4,020	4,956.54	1,403.60
Natural history specimens	8	82	8	82	81.24	208.48
Shop work	208	182	58	20	1,154.23	135.32
Miscellaneous work	52	17	52	17	8,081.52	5,249.94
Sales of publications	----	----	----	----	3,433.16	4,548.99
Refunded, work not done, etc. (deducted)	----	----	----	----	(82.75)	(102.50)
Power, gas, etc	----	----	----	----	31,995.70	31,125.23
Total	16,429	5,252	14,457	4,139	49,619.64	42,569.06
Grand total	9,599,277.33	7,180,625	9,320,399.33	7,011,863	114,738.45	98,197.62

TABLE II.—*Comparative table of routine work performed and supplies manufactured and disposed of during the fiscal year 1915, as compared with the fiscal year 1914, by number or quantity and by value, arranged with reference to Government and other patronage.*

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Bureau of Agriculture.						
Fertilizers	2	9	----	----	----	----
Soils and similar substances	11	363	----	----	----	----
Crude chemical and miscellaneous analyses	----	1	----	----	----	----
Petroleum and products, copra, and similar materials	37	----	----	----	----	----
Foods, alcohols, and beverages	64	29	----	----	----	----
Miscellaneous chemical analyses and examinations	3	123	----	----	----	----
Antirinderpest serum	134,333.33	----	134,333.33	----	230.29	----
Mallein	300	----	300	----	30.00	----
Photographic work	17	16	17	16	3.40	11.09
Standard solutions	----	1	----	1	----	5.00
Total	134,767.33	542	134,650.33	17	263.69	16.09

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Bureau of Coast and Geodetic Survey.						
Miscellaneous sera and preparations		320		320		128.00
Bureau of Customs.						
Metals and alloys	1	4				
Waters:						
Chemical	1	1				
Biological	42	51				
Crude chemical and miscellaneous analyses	8					
Petroleum and products, copra, and similar materials		1				
Paints, varnishes, and linseed oils	1	1		1		4.00
Paper and similar materials	1					
Foods, alcohols, and beverages	7					
Medicines and similar articles	1	9				
Total	62	67		1		4.00
Bureau of Education.						
Fertilizers		2				
Foods, alcohols, and beverages		1				
Photographic work	1,799		1,799		347.30	
Total	1,799	3	1,799		347.30	
Executive Bureau.						
Photographic work	135	625	135	625	62.17	182.24
Bureau of Forestry.						
Soils and similar substances		2				
Petroleum and products, copra, and similar materials	2					
Photographic work	882	156	882	156	227.17	33.99
Total	884	158	882	156	227.17	33.99
Philippine Health Service.						
Metals and alloys	1	1				
Clays, shales, limestones, limes, wall plasters, cements, and slags	1					
Waters:						
Chemical	36	14				
Biological	1,042	1,062				
Crude chemical and miscellaneous analyses	3	6				

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Philippine Health Service—Ctd.						
Fertilizers		1				
Urines, clinical and toxicological analyses	155	107				
Essential oils and essences	1					
Petroleum and products, copra, and similar materials		2				
Paints, varnishes, and linseed oils	2	5				
Gastric juice, clinical examinations	49					
Foods, alcohols and beverages	262	2, 597				
Food preservatives and coloring matters	3	10				
Medicines and similar articles	13	73				
Miscellaneous chemical analyses and examinations	34	2				
Fæces	51, 736	20, 262	80		242. 00	
Sputum	393	61	6		18. 00	
Blood	4, 393	7	134		404. 00	
Blood culture	390		2		10. 00	
Widal test	588	5, 152	4		12. 00	
Wassermann test	878	283	16		160. 00	
Leprosy	1, 108	569				
Urines	3, 087	1	79		237. 00	
Gonococci	16, 319	15, 822				
Necropsies	372	102				
Histological examinations	243	457				
Rabies	30	21				
Plague	43	1				
Rats for plague	113, 288	79, 032				
Miscellaneous biological work and examinations	1, 638	10, 021	4		28. 00	
Vaccine virus	2, 537, 800	1, 726, 560	2, 537, 800	1, 726, 560	25, 378. 00	17, 265. 60
Miscellaneous sera and preparations	4, 956, 287	3, 535, 510	4, 956, 287	3, 535, 510	10, 645. 57	8, 141. 22
Photographic work	1, 363	180	1, 363	180	1, 338. 73	102. 74
Shop work	13	1	13	1	29. 73	8. 66
Total	7, 691, 571	5, 397, 922	7, 495, 788	5, 262, 251	38, 503. 03	25, 518. 22
Bureau of Internal Revenue.						
Standardization of weights	25	7	25	7	2. 50	2. 45
Urines, clinical and toxicological analyses		1				
Medicines and similar articles	5	9				
Petroleum and products, copra, and similar materials		1				
Total	30	18	25	7	2. 50	2. 45

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Bureau of Justice.						
Gastric juice, clinical examinations		2		2		95.00
Urines, clinical and toxicological analyses	12	1	12	1	220.00	20.00
Medicines and similar articles	22	14	13	14	85.00	140.00
Blood		2		2		150.00
Miscellaneous biological work and examinations	3		3		155.00	
Total	37	19	28	19	460.00	405.00
Philippine Constabulary.						
Physical tests of wire, twine, fiber, textile, paper, and similar articles	2	1	2	1	8.50	4.00
Sputum	1					
Wassermann test	1					
Vaccine virus	2,150	2,650	2,150	2,650	21.50	26.50
Miscellaneous sera and preparations		6		6		3.00
Photographic work		2		2		3.20
Total	2,154	2,659	2,152	2,659	30.00	36.70
Philippine Exposition Board.						
Photographic work	130	49	130	49	173.07	140.00
Shop work	20		20		522.59	
Total	150	49	150	49	695.66	140.00
Bureau of Printing.						
Paper and similar materials	100	117				
Medicines and similar articles		2				
Total	100	119				
Bureau of Prisons.						
Soils and similar substances	1					
Fæces	67,183	26,927				
Sputum	1,671	1				
Blood	1,999					
Widal test	6	8				
Wassermann test	92	93				
Leprosy	19					
Urines	1,186					
Gonococci	36					
Necropsies	29	15				
Histological examinations	5	3				
Plague	1					

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Bureau of Prisons—Continued.						
Rats for plague	10					
Miscellaneous biological work and examinations	61	5				
Total	72,299	27,052				
Bureau of Public Works.						
Metals and alloys	3	3		3		29.00
Coal analyses	1					
Crude chemical and miscellaneous analyses		6				
Cements	1,587	2,014	1,587	2,014	2,306.80	3,257.10
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	22	6	22	6	64.00	24.00
Standardization of road materials	7	5	7	5	87.65	26.00
Paints, varnishes, and linseed oils	4	8	4	8	36.00	94.50
Petroleum and products, copra, and similar materials		3				
Miscellaneous chemical analyses and examinations	1					
Waters:						
Chemical	139	146				
Biological	113	106				
Photographic work		16		16		5.30
Physical tests of wire, twine, fiber, textile, paper, and similar articles		3		3		13.00
Shop work		1		1		18.00
Total	1,877	2,317	1,620	2,056	2,494.45	3,466.90
Bureau of Quarantine Service.						
Urines, clinical and toxicological analyses		1				
Fæces	6,762	1,693				
Sputum		2				
Leprosy	2					
Plague	3					
Rats for plague	39	266				
Vaccine virus	6,350	9,400	6,350	9,400	63.50	94.00
Total	13,156	11,362	6,350	9,400	63.50	94.00

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Bureau of Science.						
Metals and alloys	8	20				
Rocks, minerals, natural pigments, and similar substances		15				
Clays, shales, limestones, limes, wall plasters, cements, and slags	5	3				
Coal analyses	2	1				
Calorimetric tests of fuels	1					
Crude chemical and miscellaneous analyses	2	7				
Standard solutions	25	18				
Cements		20				
Petroleum and products, copra, and similar materials	15	2				
Paints, varnishes, and linseed oils		1				
Paper and similar materials	3					
Miscellaneous chemical analyses and examinations		6				
Waters:						
Chemical	9	1				
Biological	399	733				
Assays	8					
Fæces	73					
Rabies	5					
Miscellaneous biological work and examinations	1					
Miscellaneous sera and preparations		1				
Assays		27				
Photographic work	1,822	951				
Shop work	150	162				
Total	2,528	1,968				
Bureau of Supply.						
Metals and alloys	6	1				
Crude chemical and miscellaneous analyses	20					
Standard solutions		1		1		4.00
Physical tests of wire, twine, fibers, textiles, paper, and similar materials	29	10	29	10	82.00	31.00
Cements	4,888	3,788	4,888	3,788	4,190.00	3,522.40

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Bureau of Supply—Continued.						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	5		5		8.00	
Standardization of road materials	1		1		15.00	
Standardization of units of measures:						
Lengths	171	60	170	60	88.50	6.00
Capacities	308	121	308	121	88.70	27.10
Weights	751	24	751	24	77.45	14.50
Miscellaneous	28	21	28	21	12.00	10.50
Petroleum and products, copra, and similar materials	3	1				
Paints, varnishes, and linseed oils	17	36	12	33	145.00	172.75
Foods, alcohols, and beverages	45	49				
Medicines and similar articles	4	3				
Miscellaneous chemical analyses and examinations	24	7				
Waters:						
Chemical	8	7				
Biological	12	11				
Miscellaneous biological work and examinations	1					
Mallein	6		6		6.00	
Miscellaneous sera and preparations	60,000	10,064	60,000	10,064	60.00	45.60
Total	66,327	14,204	66,198	14,122	4,772.65	3,833.85
University of the Philippines.						
Standard solutions	2		2		2.00	
Miscellaneous chemical analyses and examinations		1		1		18.34
Fæces	126	21				
Rabies	1					
Plague	18					
Photographic work	480	531	480	531	219.15	122.20
Shop work	7	3	7	3	45.76	24.84
Total	634	556	489	535	266.91	165.38
City of Manila.						
Clays, shales, limestones, limes, wall plasters, cements, and slags	2		2		6.00	
Crude chemical and miscellaneous analyses	7	35	7	35	78.00	43.00
Cements	119	108	119	108	.20	416.35

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
City of Manila—Continued.						
Standardization of road materials	1		1		15.00	
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc		12		12		11.00
Miscellaneous chemical analyses and examinations	1	7	1	3	10.00	75.00
Waters, biological	627	1,012				
Miscellaneous biological work and examinations	5	4	5	4	68.00	20.00
Mallein	6		6		6.00	
Miscellaneous sera and preparations	189,040	168,532	189,040	168,532	193.00	200.50
Total	189,808	169,710	189,181	168,694	821.20	765.85
Provinces and municipalities.						
Metals and alloys	1		1		48.00	
Crude chemical and miscellaneous analyses	2	6	2	6	14.00	29.50
Cements	38	510	38	510	142.50	668.00
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	11	60	11	60	53.00	403.40
Standardization of road materials	6	60	6	60	52.50	403.40
Medicines and similar articles	1		1		10.00	
Waters:						
Chemical	1		1		40.00	
Biological	1		1		40.00	
Vaccine virus	65,250	30,000	65,250	30,000	3,077.50	900.00
Photographic work	37	198	37	198	27.20	66.75
Paints, varnishes, and linseed oils		2		2		31.00
Total	65,348	30,836	65,348	30,836	3,504.70	2,502.05
United States Army and Navy.						
Metals and alloys	3	4	3	4	80.00	40.00
Coal analyses	11	43	11	43	151.00	293.40
Colorimetric tests of fuels	3	23	3	23	60.00	352.00
Waters:						
Chemical	1	1	1	1	40.00	40.00
Biological		2		2		80.00
Physical tests of wire, twine, fibers, textiles, paper, and similar articles		8		8		12.00
Cements	126	61	126	61	308.00	328.50

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	**1915**	**1914**	**1915**	**1914**	**1915**
United States Army and Navy—Continued.						
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc		13		13		22.00
Crude chemical and miscellaneous analyses		1		1		5.00
Urines, clinical and toxicological analyses	2		2		50.00	
Standardization of units of measures		1		1		5.00
Petroleum and products, copra, and similar materials	1	1	1	1	16.00	15.00
Paints, varnishes, and linseed oils	14	2	14	2	108.00	30.00
Foods, alcohols, and beverages	11	6	7	6	96.00	78.00
Vaccine virus	22,172	18,330	22,172	18,330	717.80	588.50
Mallein	328	10	328	10	328.00	10.00
Miscellaneous sera and preparations	528,831	767,744	528,831	767,744	2,184.35	1,763.80
Shop work	1		1		5.18	
Total	551,504	786,250	551,500	786,250	4,144.33	3,663.20
Miscellaneous.						
Metals and alloys	28	11	28	11	308.50	174.00
Clays, shales, limestones, limes, wall plasters, cements, and slags	3	2	3	2	21.00	28.00
Fertilizers	12	22	12	22	132.00	246.20
Soils and similar substances	30		30		693.00	
Coal analyses	8	6	8	6	125.00	92.00
Calorimetric tests of fuels	3	11	3	11	60.00	320.00
Crude chemical and miscellaneous analyses	49	73	49	73	197.50	419.50
Physical tests of wire, twine, fibers, textiles, paper, and similar articles		10		10		27.00
Standard solutions	3		3		27.00	
Cements	59	215	59	215	248.70	1,234.80
Compression, tensile, or transverse strength of concrete, stone, mortar, rope, iron and steel, etc	48	112	48	112	205.00	175.00
Standardization of road materials		6		6		38.00
Standardization of units of measures:						
Capacities	4		4		10.70	
Miscellaneous	13		13		42.00	

TABLE II.—*Comparative table of routine work, etc.*—Continued

Patron.	Total work performed.		Cash work.			
	Samples or units.		Samples or units.		Pesos.	
	1914	1915	1914	1915	1914	1915
Miscellaneous—Continued.						
Urines, clinical and toxicological analyses	63	82	63	79	199.00	254.00
Essential oils and essences	13	11	13	11	89.50	77.50
Petroleum and products, copra, and similar materials	10	9	10	9	73.50	83.00
Paints, varnishes, and linseed oils	4	8	3	8	30.00	80.40
Gums, resins, and similar materials	----------	1	----------	1	----------	5.00
Gastric juice, clinical examinations	3	----------	3	----------	15.00	----------
Foods, alcohols, and beverages	251	239	249	239	788.00	873.20
Food preservatives and coloring matters	2	15	2	15	4.00	89.00
Medicines and similar articles	2	10	2	10	45.00	345.00
Miscellaneous chemical analyses and examinations	23	32	23	32	90.00	204.70
Assays	403	650	403	650	653.45	957.76
Waters:						
Chemical	13	31	13	31	285.00	571.50
Biological	7	9	7	9	280.00	270.00
Fæces	346	1,118	346	1,118	1,129.00	3,352.33
Sputum	30	21	30	21	90.00	63.00
Blood	6	20	6	20	18.00	60.00
Blood culture	2	2	2	2	10.00	10.00
Widal test	5	6	5	6	21.00	18.00
Wassermann test	288	257	288	257	2,880.00	2,502.88
Leprosy	3	----------	3	----------	9.00	----------
Urines	2	1	2	1	5.00	25.00
Gonococci	24	10	24	10	72.00	30.00
Histological examinations	8	13	8	13	80.00	130.00
Miscellaneous biological work and examinations	46	5	46	5	297.00	28.00
Vaccine virus	2,613	1,726	2,613	1,726	124.75	102.00
Mallein	175	----------	175	----------	175.50	----------
Miscellaneous sera and preparations	789,932	726,764	789,932	726,764	1,926.90	2,502.88
Photographic work	9,496	2,247	9,496	2.247	2,558.35	736.09
Natural-history specimens	8	82	8	82	81.24	208.48
Shop work	17	15	17	15	550.97	83.82
Miscellaneous work	52	17	52	17	8,081.52	5,249.94
Sales of publications	----------	----------	----------	----------	3,433.16	4,548.99
Refunded, work not done, etc. (deducted)	----------	----------	----------	----------	(82.75)	(102.50)
Power, gas, etc	----------	----------	----------	----------	31,995.70	31,125.23
Total	804,107	733,869	804,104	733,866	58,079.19	57,239.70
Grand total	9,599,277.33	7,180,625	9,320,399.33	7,011,863	114,738.45	98,197.62

TABLE III.—*Comparative statement showing expenditures and income during the fiscal year 1915 (January 1 to December 31, 1915) as compared with the fiscal year 1914.*

EXPENDITURES.

Item.	Fiscal year 1914.	Fiscal year 1915.
Salaries and wages, etc.:	*Pesos.*	*Pesos.*
Salaries and wages, including accrued leave	224,113.73	191,349.75
Traveling expenses of personnel	14,212.98	12,026.16
Total	238,326.71	203,375.91
Apparatus, supplies, etc.:		
Consumption of supplies and materials, including subscriptions	74,407.70	73,156.96
Apparatus and equipment, including books	25,450.77	14,448.88
Total	99,858.47	87,605.84
Miscellaneous:		
Rental of buildings	720.00	682.50
Postal, telegraph, telephone, and cable service	4,932.12	4,764.62
Freight, express, and delivery service	980.09	1,176.32
Printing and binding reports, documents, and publications	28,695.67	33,590.61
Illumination and power service	402.53	1,647.02
Contingent service	3,631.71	3,079.95
Maintenance and repair of furniture and equipment	712.92	4,409.75
Total	40,075.04	49,350.77
Grand total	378,260.22	340,332.52

INCOME.

	Pesos.	*Pesos.*
Receipts from operation	115,486.73	98,197.62
Prior year income	(838.20)	2,665.88
Sales of supplies	488.82	.73
Sales of fixed assets	2,716.45	25,889.93
Total	117,853.80	126,754.16

MISCELLANEOUS ACCOUNTS (1915).

Item.	Available.	Expended.	Balance.
	Pesos.	*Pesos.*	*Pesos.*
Tiqui-tique distribution, Act No. 2376	5,056.64	1,524.00	3,532.64
Improvement of the Aquarium, Act No. 2494	2,000.00		2,000.00
Replacement fund	1,344.21	1,344.21	
Public Works: Alterations to boiler, Act No. 1989	794.00	794.00	
Library equipment, Act No. 1988	1,572.57	1,572.57	
Total	10,767.42	5,234.78	5,532.64

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